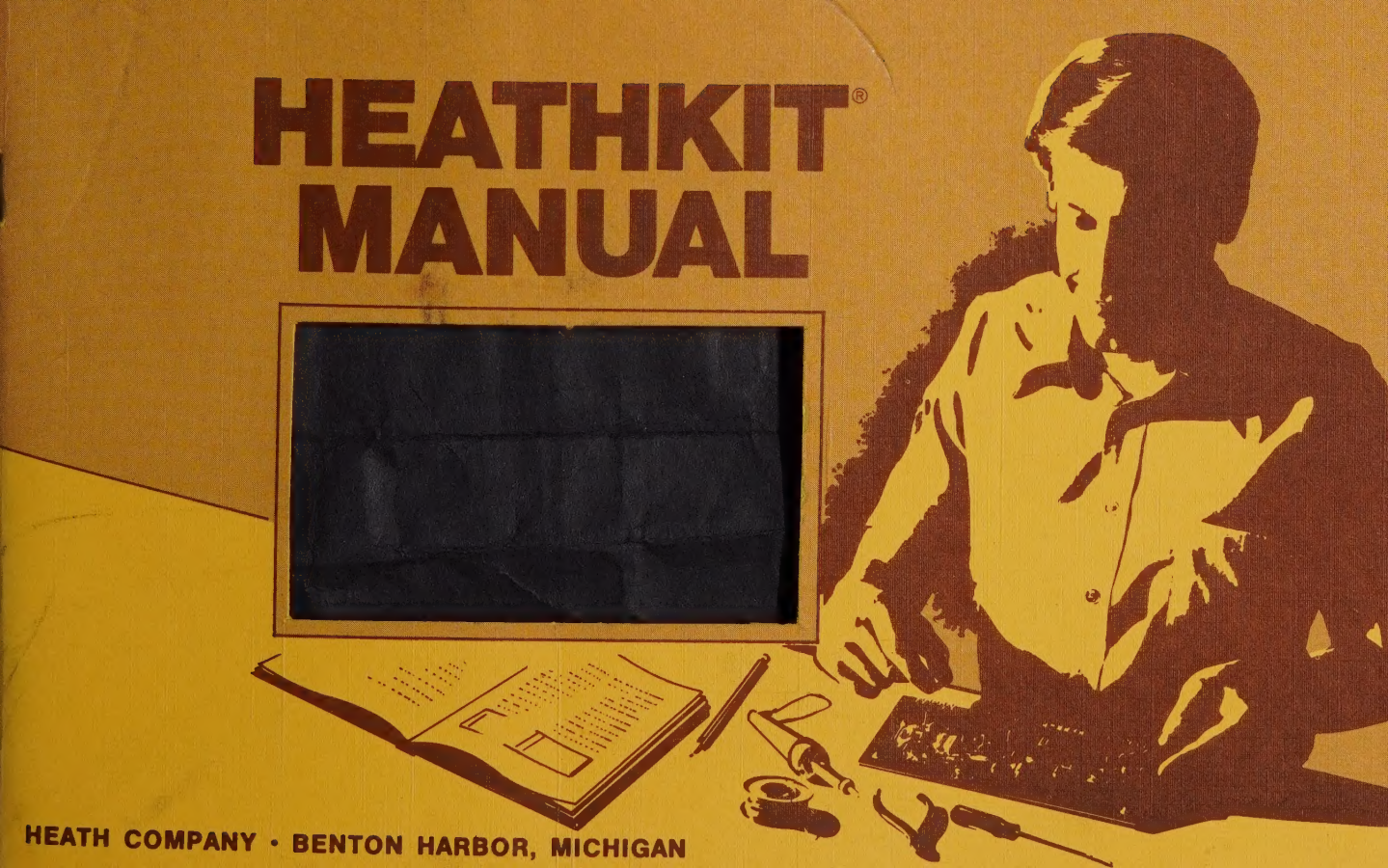
HEATHKIT® MANUAL



HEATH COMPANY • BENTON HARBOR, MICHIGAN

YOUR HEATHKIT 90 DAY LIMITED WARRANTY

If you are not satisfied with our service - warranty or otherwise - or with our products, write directly to our Director of Customer Services, Heath Company, Benton Harbor, Michigan 49022. He will make certain your problems receive immediate, personal attention.

Our attorney, who happens to be quite a kitbuilder himself, insists that we describe our warranty using all the necessary legal phrases in order to comply with the new warranty regulations. Fine. Here they are:

For a period of ninety (90) days after purchase, Heath Company will replace or repair free of charge any parts that are defective either in materials or workmanship. You can obtain parts directly from Heath Company by writing us at the address below or by telephoning us at (616) 982-3571. And we'll pay shipping charges to get those parts to you — anywhere in the world.

We warrant that during the first ninety (90) days after purchase, our products, when correctly assembled, calibrated, adjusted and used in accordance with our printed instructions, will meet published specifications.

If a defective part or error in design has caused your Heathkit product to malfunction during the warranty period through no fault of yours, we will service it free upon proof of purchase and delivery at your expense to the Heath factory, any Heathkit Electronic Center (units of Schlumberger Products Corporation), or any of our authorized overseas distributors.

You will receive free consultation on any problem you might encounter in the assembly or use of your Heathkit product. Just drop us a line or give us a call. Sorry, we cannot accept collect calls.

Our warranty does not cover and we are not responsible for damage caused by the use of corrosive solder, defective tools, incorrect assembly, misuse, fire, or by unauthorized modifications to or uses of our products for purposes other than as advertised. Our warranty does not include reimbursement for customer assembly or set-up time.

This warranty covers only Heathkit products and is not extended to allied equipment or components used in conjunction with our products. **We are not responsible for incidental or consequential damages.** Some states do not allow the exclusion or limitation of incidental or consequential damages, so the above limitation or exclusion may not apply to you. This warranty gives you specific legal rights, and you may also have other rights which vary from state to state.

HEATH COMPANY
BENTON HARBOR, MI. 49022

HEATH COMPANY PHONE DIRECTORY

The following telephone numbers are direct lines to the departments listed:

Kit orders and delivery information	(616) 982-3411
Credit	(616) 982-3561
Replacement Parts	(616) 982-3571

Technical Assistance Phone Numbers
8:00 A.M. to 12 P.M. and 1:00 P.M. to 4:30 P.M., EST, Weekdays Only

R/C, Audio, and Electronic Organs	(616) 982-3310
Amateur Radio	(616) 982-3296
Test Equipment, Weather Instruments and Home Clocks	(616) 982-3315
Television	(616) 982-3307
Aircraft, Marine, Security, Scanners, Automotive, Appliances and General Products	(616) 982-3496
Computers	(616) 982-3309

Prices and specifications subject to change without notice.

Heathkit® Manual

for the

DELUXE DIGITAL STOPWATCH

Model GB-1201/GB-1201E

595-1820-03

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HEATH COMPANY
BENTON HARBOR, MICHIGAN 49022

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INTRODUCTION

The Heathkit Model GB-1201/GB-1201E Deluxe Digital Stopwatch is a compact, handheld, electronic digital stopwatch. It is basically seven instruments in one, in that a single switch allows you to select seven different timing modes or functions. Time is displayed in easy-to-read digital numbers – no more will you have to interpret the moving sweep hand of an ordinary mechanical stopwatch. Events as long as 99 hours, 59 minutes, 59.99 seconds can be accurately measured to within 1/100 second.

Use your Deluxe Digital Stopwatch to precisely time any event. All types of sporting events (such as automobile racing and rallies, boating, flying, track, swimming, and skiing), as well as industrial uses (machine timing, time studies, etc.), are only a few of its many and varied applications. Use your Stopwatch to time participants or to time the difference between participants in any event.

Many outstanding features have been engineered into your Stopwatch. The heart of the sophisticated timing circuitry is formed by two custom designed, state-of-the-art, integrated circuits*. The time is clearly displayed on seven-segment numerical displays. The small, compact, styling of the Stopwatch provides one-hand (either right or left) operation of the start and stop functions. The handy carrying strap lets you carry the Stopwatch either around your neck or by hand.

Its self-contained, rechargeable, nickel-cadmium batteries provide many hours of reliable portable operation. In addition, a separate charger is supplied to recharge the batteries, as well as power the Model GB-1201 Stopwatch at locations where 120 VAC, 60 Hz power is available. Another Converter Charger is supplied with the Model GB-1201E Stopwatch which allows you to charge the batteries and power the Stopwatch from a 120/240 volt, 50/60 Hz power source. However, the Model GB-1201E Converter Charger is in kit form and it must be assembled as directed in the separate Converter Charger Manual before you assemble the Stopwatch.

All of these features and inovations are incorporated into your Deluxe Digital Stopwatch to give you many years of trouble-free, split-second timing.

Refer to the "Kit Builders Guide" for complete information on unpacking, parts identification, tools, wiring, soldering, and step-by-step assembly procedures.

*Ion Implantation Depletion Mode, P– channel MOS (Metal Oxide Semiconductor) integrated circuit (I^2D PMOS).

PARTS LIST

Check each part against the following list. Make a check mark (✓) in the space provided as you identify each part. Any part that is packed in an individual envelope with the part number on it should be placed back in the envelope after you identify it until it is called for in a step. Do not discard any packing materials until all parts are accounted for. The key numbers correspond to the numbers on the Parts Pictorials.

CAUTION: The integrated circuits (#443-699 and #443-693) can be damaged by static voltage. Since this part represents a considerable portion of the cost of the kit, do not remove it from its package until you are instructed to do so.

To order a replacement part, always include the PART NUMBER. Use the Parts Order Form furnished with this kit. If one is not available, see "Replacement Parts" inside the rear cover of the Manual. Your Warranty is located inside the front cover. For pricing information, refer to the separate "Heath Parts Price List."

KEY No.	QTY.	DESCRIPTION	PART No.	CIRCUIT Component No.

RESISTORS

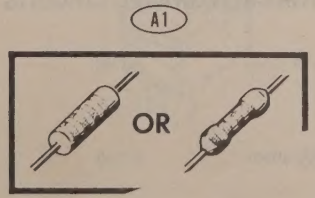
NOTE: All resistors have a 10% tolerance (silver fourth band).

1/4-Watt

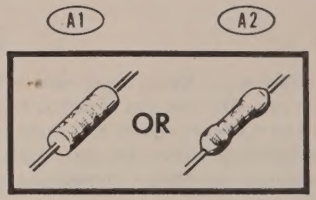
A1( )	7	150 Ω (brown-green-brown)	1-37-12	R201, R202, R203, R204, R205, R206, R207

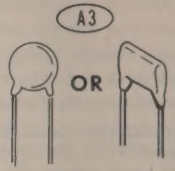
Each circuit part in this kit has its own "Circuit Component Number" (R202, C102, V201, etc.). This is a specific number for only that one part. The purpose of these numbers is to help you easily identify the same part in each section of the Manual. These numbers will appear:

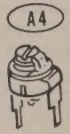
- In the Parts List;
- At the beginning of each step where a component is installed;
- In some illustrations;
- On the Schematic;
- In the sections at the rear of the Manual.

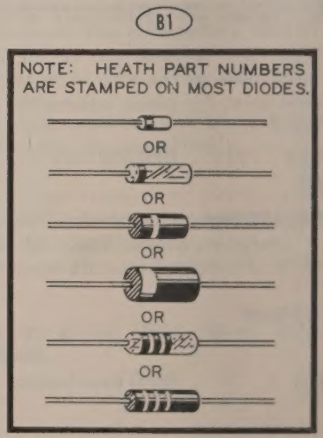


KEY No.	QTY.	DESCRIPTION	PART No.	CIRCUIT Component No.
Resistors (cont'd.)				
A1 ( )	3	100 kΩ (brown-black-yellow)	1-32-12	R101, R103, R104
A1 ( )	1	10 MΩ (brown-black-blue)	1-88-12	R102
1/2-Watt				
A2 (	1	27 Ω (red-violet-black)	1-153	R208
CAPACITORS				
A3 ( )	1	47 pF ceramic	21-710	C102
A4 ( )	1	3.2-18 pF trimmer	31-71	C101
DIODES-TRANSISTORS-INTEGRATED CIRCUITS				
B1 ( )	7	1N4149 diode	56-56	D101, D102, D103, D104, D105, D106, D109
B1 ( )	1	1N4002 diode	57-65	D201









KEY No.	QTY.	DESCRIPTION	PART No.	CIRCUIT Component No.

Diodes-Transistors-Integrated Circuits (cont'd.)

NOTE: Transistors and integrated circuits are marked for identification in one of the following four ways:

1. Part number.
2. Type number. (For integrated circuits this refers only to the numbers; the letters may vary.)
3. Part number and type number.
4. Part number with a type number other than the one listed.

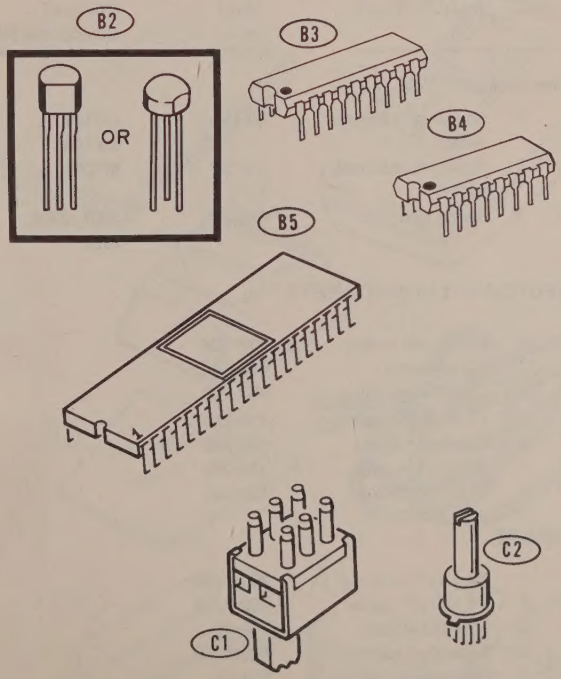
B2 ( )	1	2N4121 transistor	417-235	Q101
B3 ( )	1	DS/DM8863, 18-pin integrated circuit	443-700	IC202

CAUTION: The following integrated circuits (#443-699 and #443-693) can be damaged by static electricity. Do not remove them from their boxes until you are instructed to do so in a step.

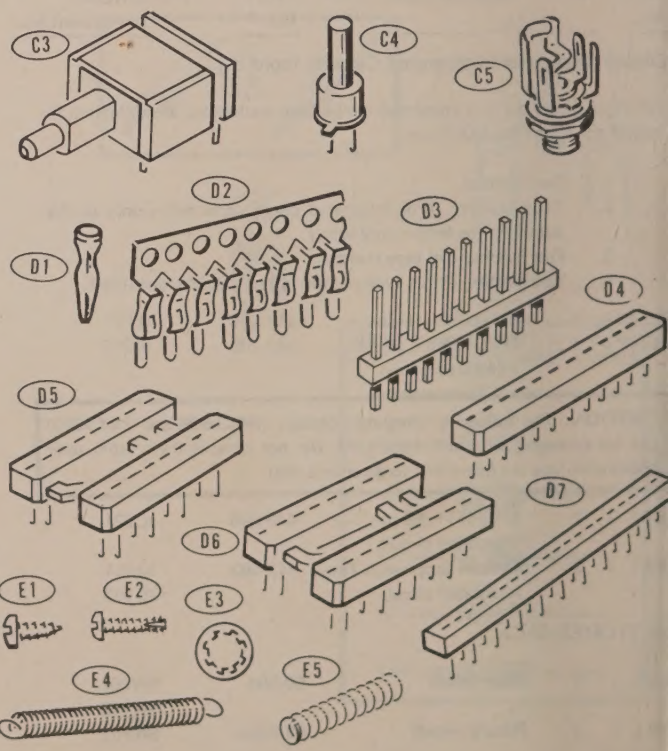
B4 ( )	1	MM14511, 16-pin integrated circuit	443-699	IC201
B5 ( )	2	Custom Stopwatch Timer integrated circuit	443-693	IC101, IC102

SWITCHES-JACK

C1 ( )	2	Slide switch	60-604	SW201, SW203
C2 ( )	1	Rotary switch	63-1256	SW101

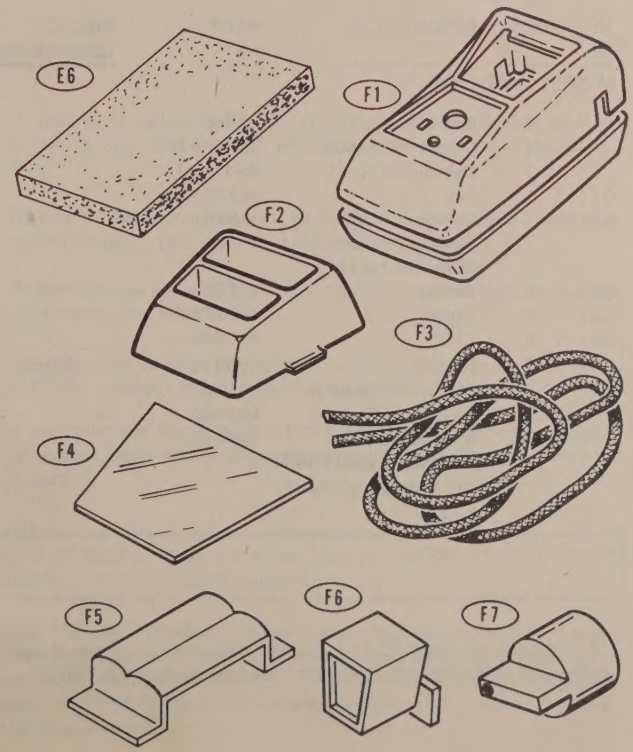


KEY No.	QTY.	DESCRIPTION	PART No.	CIRCUIT Component No.
Switches-Jack (cont'd.)				
C3 ( )	2	Square pushbutton switch	64-785	SW102, SW103
C4 ( )	1	Round pushbutton switch	64-786	SW202
C5 ( )	3	Phone jack	436-28	J301, J302, J303
CONNECTORS-PLUGS-SOCKETS				
D1 ( )	22	Connector socket	432-134	
D2 ( )	12	IC connector	432-144	
D3 ( )	2	Circuit board plug	432-903	
D4 ( )	4	12-pin LED socket	434-290	
D5 ( )	1	16-pin IC socket	434-295	
D6 ( )	1	18-pin IC socket	434-296	
D7 ( )	4	20-pin IC socket	434-297	
HARDWARE				
E1 ( )	4	#4 x 1/4" screw	250-1226	
E2 ( )	3	#4 x 7/16" screw	250-1218	
E3 ( )	3	#10 lockwasher	254-36	
E4 ( )	1	Expansion spring	258-4	
E5 ( )	2	Compression spring (heavy)	258-47	
E5 ( )	2	Compression spring (light)	258-165	



KEY No.	QTY.	DESCRIPTION	PART No.	CIRCUIT Component No.
WIRE-TAPE-PAD				
( )	3"	Orange stranded wire	344-93	
( )	24"	White wire	344-141	
( )	18"	Red wire	344-142	
( )	18"	Black wire	344-143	
( )	5"	Foam tape	73-92	
( )	1	Roll of tape	74-6	
E6 ( )	1	Foam pad	382-75	
( )	1"	Sleeving	346-35	
CABINET PARTS				
F1 ( )	1	Cabinet set (top and bottom)	92-632	
F2 ( )	1	Light shield	94-570	
F3 ( )	1	Cabinet strap	267-11	
( )	1	Set of labels	390-1226	
F4 ( )	1	Red window	446-655	
F5 ( )	1	Magnifying window	446-661	
F6 ( )	2	Square pushbutton switch knob	462-964	
F7 ( )	1	Rotary switch knob	462-965	

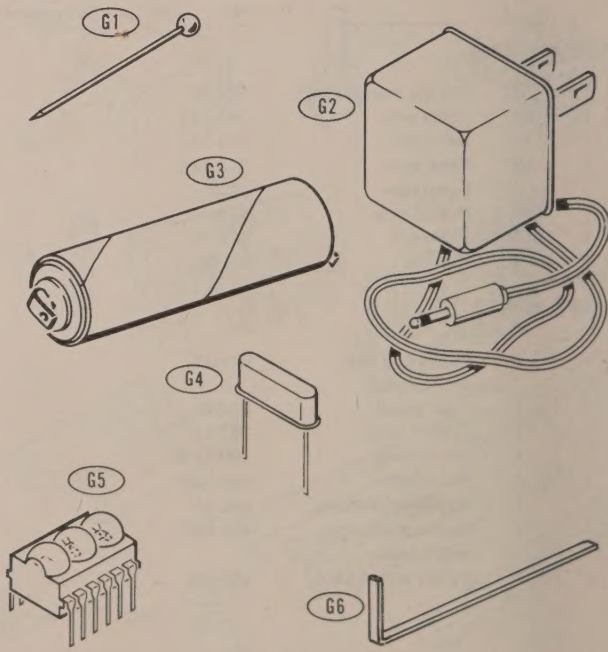
*Write to Heath Co. for price information



MISCELLANEOUS

KEY No.	QTY.	DESCRIPTION	PART No.	CIRCUIT Component No.
( )	1	Insulating paper	75-108	
( )	1	Display circuit board	85-1674-2	
( )	1	Main circuit board	85-1710-3	
G1 ( )	1	Pin	262-43	
G2 ( )	1	Converter charger (not supplied with Model GB-1201E)	150-59	
G3 ( )	6	Battery	418-32	
G4 ( )	1	Crystal	404-572	
G5 ( )	4	LED*	411-832	
G6 ( )	1	IC puller	490-111	
( )	1	Blue and white label	391-34	
( )	1	Parts Order Form	597-260	
( )	1	Kit Builders Guide	597-308	
	1	Assembly Manual (See front cover for part number.)		
		Solder		

*A brightness code letter (G, H, I, or J) is stamped on the bottom of each LED. Include this brightness code letter when you order replacement LED's.



ASSEMBLY NOTES

1. Before you start to assemble this kit, read the wiring, soldering, and step-by-step assembly information in the "Kit Builders Guide."

2. Due to the small foil area around the circuit board holes and the small areas between foils, it will be necessary to use the utmost care to prevent solder bridges between adjacent foil areas. Use only a miminum amount of solder and do not heat components excessively with the soldering iron. Use no larger than a 40-watt soldering iron with a small tip. Allow it to reach operating temperature, and then apply it only long enough to make a good solder connection. If you think a solder bridge may exist but are not sure, compare the foil on the circuit board with the "Circuit Board X-Ray Views" in the rear of the Manual.

3. To eliminate a solder bridge, hold the circuit board above the soldering iron and reheat the solder. As the solder melts; it will flow down the iron.

4. The circuit boards have foil on both sides of the board. Components will be installed on the lettered (component outline) side, and the leads will be soldered to the foil on the other side. Never make a solder connection on the component side of the circuit board unless you are specifically instructed to do so.

5. Due to the nature of the board, solder may be drawn through a circuit board hole to the lettered side. This is normal, as many of the holes are "plated through" to connect the foils on both sides of the board together. However, do not allow solder to flow into unused holes when soldering components to the foil.

6. If your work surface is smooth, place the circuit board on a cloth to prevent it from sliding around when you solder component leads to the foil.

7. Because of the limited space in the Stopwatch, it is important that you mount all parts as tight against the circuit boards as possible.

8. Resistors will be called out by their resistance value in Ω (ohms) or kΩ (1000 ohms), and color code.

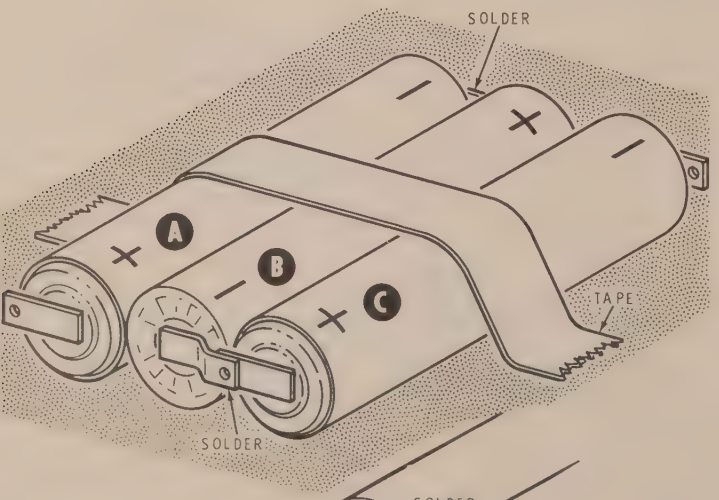
9. Capacitors will be called out by their capacitance value in pF (picofarad) or μF (microfarad) and type (mica and tantalum).

10. If you purchased the Model GB-1201E Stopwatch, refer to the separate Converter Charger Manual and assemble the Converter Charger before you proceed.

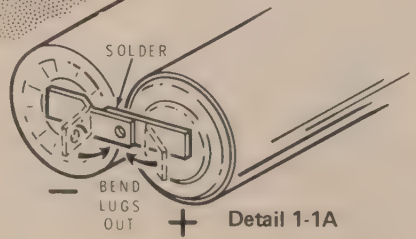
SAFETY WARNING: Avoid eye injury when you clip off excess lead lengths. Hold the leads so they cannot fly toward your eyes.

A separate "Illustration Booklet" contains numbered illustrations (Pictorials, Details, etc.) that are too large for the Assembly Manual. The step-by-step assembly instructions will direct you to the proper illustration in the Booklet. After you have completed the assembly of your kit, place the Illustration Booklet with the Manual and save them for future reference.

BATTERY PACK ASSEMBLY



PICTORIAL 1-1



Detail 1-1A

Refer to Pictorial 1-1 for the following steps.

( ) Locate the six batteries, the roll of tape, the insulating paper, and the red and black wires.

NOTE: Perform the following steps twice, once for each set of three batteries, where two check off spaces have been provided.

( ) ( ) Refer to Detail 1-1A and note the difference between the positive (+) and negative (–) end of each battery. The negative (–) tab of a battery is easily distinguished, since it is always connected directly to the metal battery case. The positive (+) tab is connected to the insulated "button end." Bend the lugs as shown.

( ) Note: The batteries supplied with your kit may have a cardboard sleeve on them. Slide this sleeve back to identify the metal battery case. The (-) tab is always connected directly to the metal battery case.

( ) ( ) Refer to the Pictorial and tape three batteries to your work surface so they are positioned as follows:

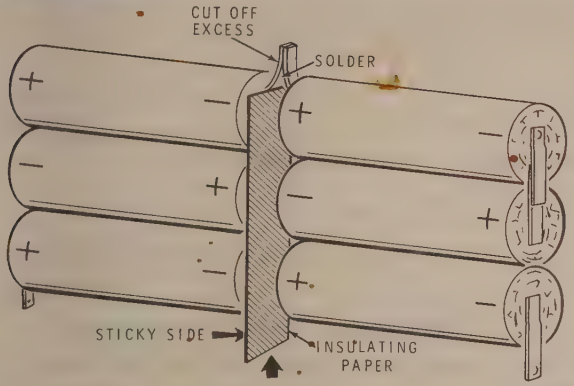
1. The tab on the negative (–) end of battery A is touching the tab on the positive (+) end of battery B.

2. The tab on the negative (–) end of battery B is touching the positive (+) end of battery C.

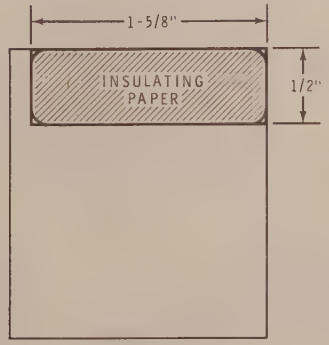
( ) ( ) Solder the tab on the negative (–) end of battery A to the tab on the positive (+) end of battery B.

( ) ( ) Solder the tab on the negative (–) end of battery B to the tab on the positive (+) end of battery C.

( ) Leave one of the 3 battery sets taped on your work surface.



PICTORIAL 1-2



Detail 1-2A

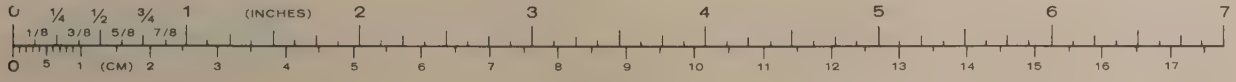
Refer to Pictorial 1-2 for the following steps.

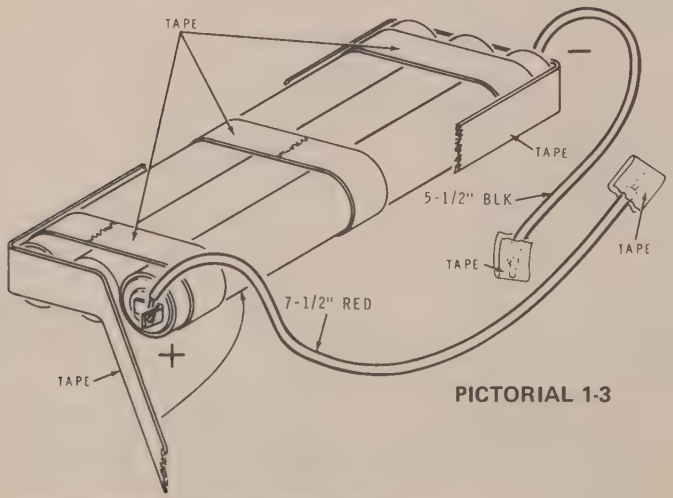
( ) Position the two 3-battery sets so the positive (+) tab of one set is near the negative (–) tab of the other set. Do not let the two sets of batteries touch each other.

( ) Refer to Detail 1-2A and cut a 1/2" x 1-5/8" piece of insulating paper from the larger piece. Round the corners as shown.

( ) Remove the backing paper from the 1/2" x 1-5/8" piece of insulating paper and press the insulating paper onto the ends of the indicated 3-battery set.

( ) Slide the two sets of batteries together and solder the positive (+) tab to the negative (–) tab. Then cut off the excess tab that extends beyond the sides of the batteries.





PICTORIAL 1-3

Refer to Pictorial 1-3 for the following steps.

( ) Remove the tape holding three of the batteries to your work surface.

( ) Wrap the tape around the middle of the batteries as shown. Be careful that the piece of insulating paper does not fall out from between the batteries. Wrap the tape at least three times around the batteries.

( ) Wrap tape around each end of the batteries as shown. Wrap it at least three times around the batteries.

NOTE: To prepare wire, cut it to the indicated length and remove 1/4" of insulation from each end.

( ) Prepare a 7-1/2" red wire and a 5-1/2" black wire.

( ) Cut two 1" lengths of tape.

( ) Place a 1" length of tape over the bare wire at one end of the 7-1/2" red wire.

( ) Place a 1" length of tape over one end of the 5-1/2" black wire.

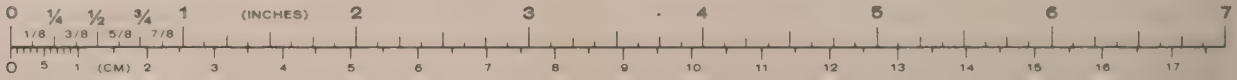
NOTE: In the following steps, (NS) means not to solder because other wires will be added later. "S-" with a number, such as (S-1), means to solder the connection. The number following the "S" tells how many wires are at the connection.

( ) Connect the other end of the red wire to the positive (+) tab of the batteries as shown (S-1).

( ) Connect the other end of the black wire to the negative (–) tab of the batteries (S-1).

( ) Place a length of tape across each end of the batteries as shown.

This completes the battery pack assembly. Set it aside and proceed to "Display Circuit Board Assembly."

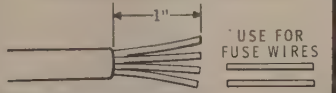


DISPLAY CIRCUIT BOARD ASSEMBLY

START

( ) Position the display circuit board as shown, lettered-side-up. Then complete each step on the following Pictorials.

( ) Prepare two fuse wires as follows: Remove 1" of insulation from one end of the orange stranded wire. Then select and cut off **any two of the individual 1" strands of wire** for use in the following steps. Save the orange stranded wire for use as replacement fuses. Tape the orange stranded wire to the battery pack for use in the future if you wish.

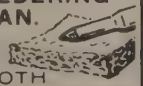


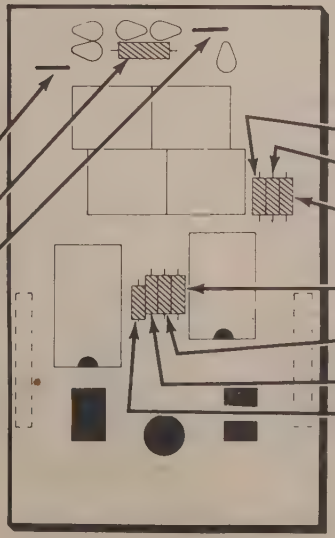
( ) F1: Fuse wire.

( ) R208: 27 Ω (red-violet-black).

( ) F2: Fuse wire.

FOR GOOD SOLDER CONNECTIONS, YOU MUST **KEEP THE SOLDERING IRON TIP CLEAN.** WIPE IT OFTEN WITH A DAMP SPONGE OR CLOTH





CONTINUE

( ) Turn the circuit board over and solder the leads to the foil. Then cut off the excess lead lengths.

( ) R205: 150 Ω (brown-green-brown).

( ) R202: 150 Ω (brown-green-brown).

( ) R203: 150 Ω (brown-green-brown).

( ) R206: 150 Ω (brown-green-brown).

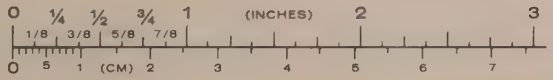
( ) R201: 150 Ω (brown-green-brown).

( ) R207: 150 Ω (brown-green-brown).

( ) R204: 150 Ω (brown-green-brown).

( ) Turn the circuit board over and solder the leads to the foil. Then cut off the excess lead lengths.

PICTORIAL 2-1



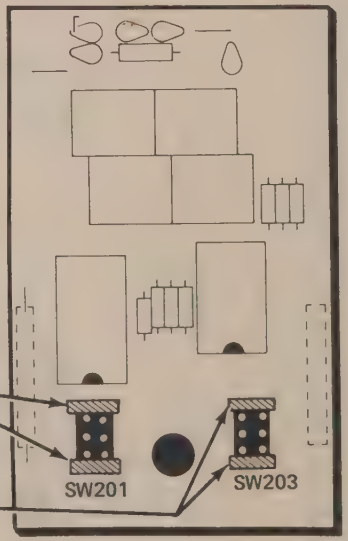
START

( ) Locate the set of labels.

NOTE: The small rectangular strips, on the set of labels, will be used in the following steps as insulators. They will prevent the metal cases of the slide switches from touching the circuit board foils when the switches are installed.

( ) Remove two of the small rectangular strips. Press the strips onto the circuit board at SW201. Position them close to, but not covering the switch lug holes.

( ) Likewise, install two small rectangular strips at SW203.



PICTORIAL 2-2

START

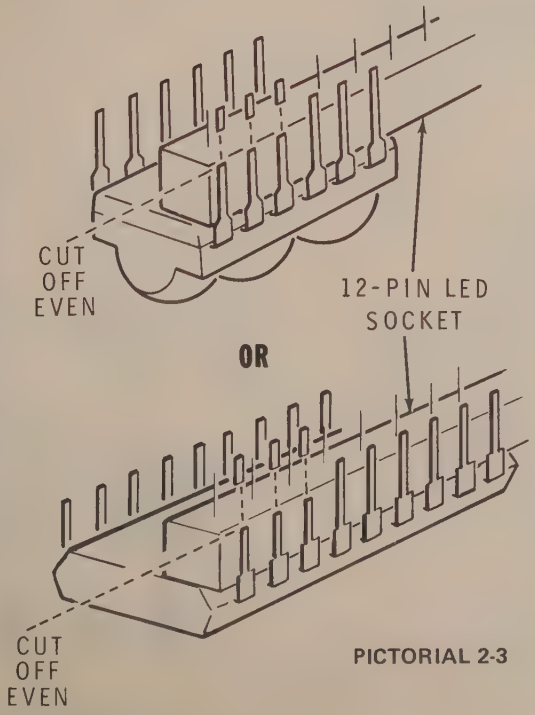
( ) Locate the four LED's (#411-832) and the DS/DM8863 18-pin integrated circuit (#443-700).

( ) Locate a 12-pin LED socket. This will be used to measure pin lengths in the following steps.

( ) Place the socket between the rows of LED pins. If the pins extend beyond the edge of the socket, carefully cut off each pin so it is even with the edge of the socket.

( ) Carefully measure and cut off (if necessary) all of the pins on the remaining LED's and on the 18-pin integrated circuit.

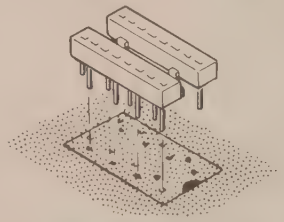
( ) Set the socket, LED's and integrated circuit aside. They will be called for later.



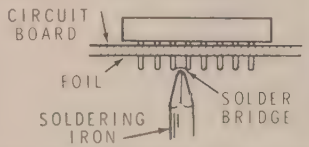
PICTORIAL 2-3

START

You will install IC sockets in the following steps. Be sure the socket pins are straight. Insert the pins in their respective holes, turn the circuit board over, and solder them to the foil.

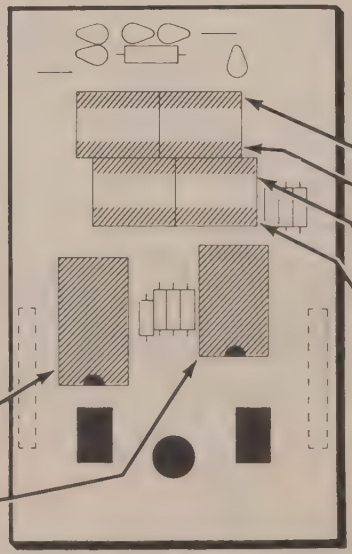


If a solder bridge occurs, clean the soldering iron tip and place it between the two points that are bridged until the excess solder flows down the tip.



( ) 18-pin IC socket at IC202.

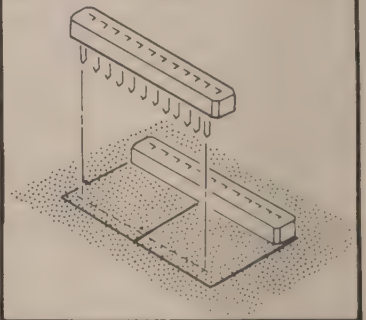
( ) 16-pin IC socket at IC201. This socket can be installed either way.



PICTORIAL 2-4

CONTINUE

NOTE: To install the 12-pin LED sockets, insert the pins and solder them to the foil. Make sure the socket is not tilted and is flush against the circuit board before you solder the pins. Solder only the pins that have foil around them.



( ) 12-pin LED socket at V203, V204

( ) 12-pin LED socket V203, V204.

( ) 12-pin LED socket at V201, V202.

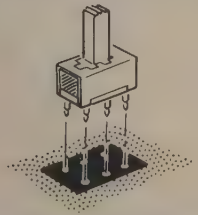
( ) 12-pin LED socket at V201, V202.

( ) Cut off the excess pin lengths.

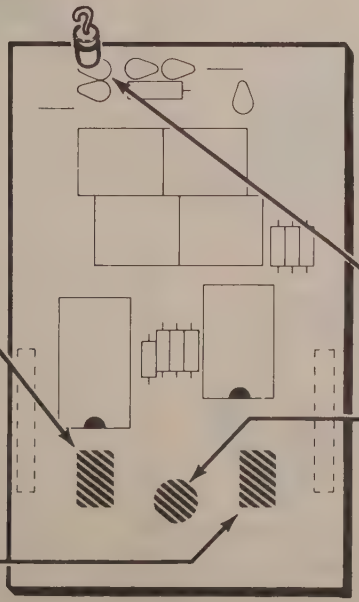
START

NOTE: When you install the switches in the following steps, turn the circuit board over and solder the lugs to the foil as you install each switch.

( ) SW201: Slide switch (#60-604).



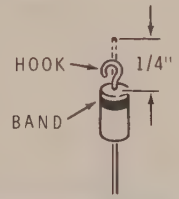
( ) SW203: Slide switch (#60-604).



PICTORIAL 2-5

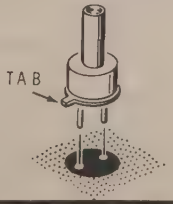
CONTINUE

( ) Cut the lead at the banded end of a 1N4002 diode (#57-65) to 1/4". Then form a small hook in the 1/4" lead as shown.



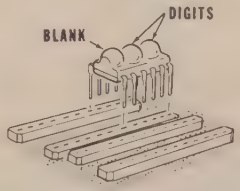
( ) D201: Insert the other lead into hole AA and solder it to the foil. Cut off the excess lead length.

( ) SW202: Round pushbutton switch (#64-786). The tab can go either way. The metal housing of the round pushbutton switch will touch a foil on the component side of the circuit board. This will not affect the operation of the Stopwatch.



START

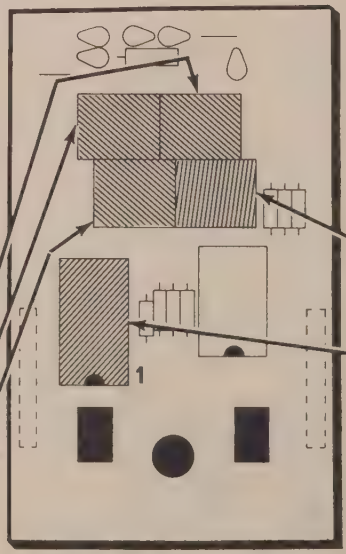
NOTE: Each LED has three sections. One section of each LED is blank. In the next three steps install the LED's so the blank section is toward the left as shown. Then insert the LED pins into their corresponding socket hole and press the LED firmly against the socket.



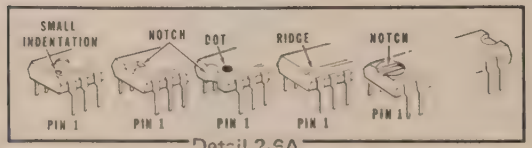
( ) V203: LED (#411-832).

( ) V204: LED (#411-832).

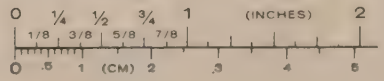
( ) V202: LED (#411-832).



PICTORIAL 2-6

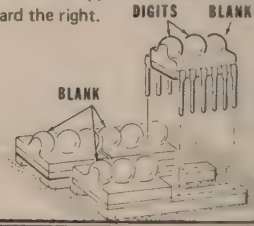


Detail 2-6A



CONTINUE

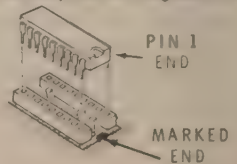
NOTE: In the next step, install the LED so the blank section is toward the right.



( ) V201: LED (#411-832).

( ) IC202: Locate a DS/DM8863 18-pin integrated circuit (#443-700). Then refer to Detail 2-6A and identify the pin 1 end. Integrated circuits may be marked in various ways.

Position the pin 1 end of the integrated circuit over the marked end of the outline printed on the circuit board. Then insert the integrated circuit pins into their corresponding socket holes and press the integrated circuit down into the socket.



Refer to Pictorial 2-7 (in the "Illustration Booklet") for the following steps.

NOTE: When the term "foil side" is used in the following steps, it refers to the side of the circuit board that DOES NOT have components mounted on it.

( ) Insert a circuit board plug in holes 1 through 10 from the foil side of the circuit board as shown. Make sure the plug is seated against the circuit board. Then solder one pin to the foil on the lettered side of the board. Check the plug to make sure it is straight and properly seated against the circuit board. Then solder the remaining pins to the foil.

( ) In the same way, install a circuit board plug in holes 11 through 20.

( ) Prepare a 1-1/2" red wire, a 1-1/2" black wire, and a 1-1/2" white wire.

Connect one end of each wire to the circuit board as directed in the following steps. Insert the wire through the circuit board from the lettered side and solder it to the foil on the other side. Then cut off the excess wire lengths.

( ) White wire to hole AC.

( ) Red wire to hole AD.

( ) Connect one end of the black wire to the hooked lead of diode D201. Solder the connection.

( ) Cut a 1/2" length of sleeving and slide it onto the black lead and over diode D201.

( ) Locate a phone jack. Save the nut, but discard the flat washers.

( ) Refer to inset drawing #1 on Pictorial 2-7 and identify the lugs. This jack will be wired into the circuit as the Power jack, J301.

NOTE: When you connect wires to the phone jack in the following steps, position the wires at right angles to the lugs before you solder them. See inset drawing #2.

( ) J301: Connect the black wire coming from display circuit board hole AA to jack J301 lug 1 (S-1).

( ) J301: Connect the red wire coming from display circuit board hole AD to jack J301 lug 2 (S-1).

( ) J301: Connect the white wire coming from display circuit board hole AC to jack J301 lug 3 (S-1).

CIRCUIT BOARD CHECKOUT

Carefully inspect the circuit board for the following conditions:

( ) Unsoldered connections.

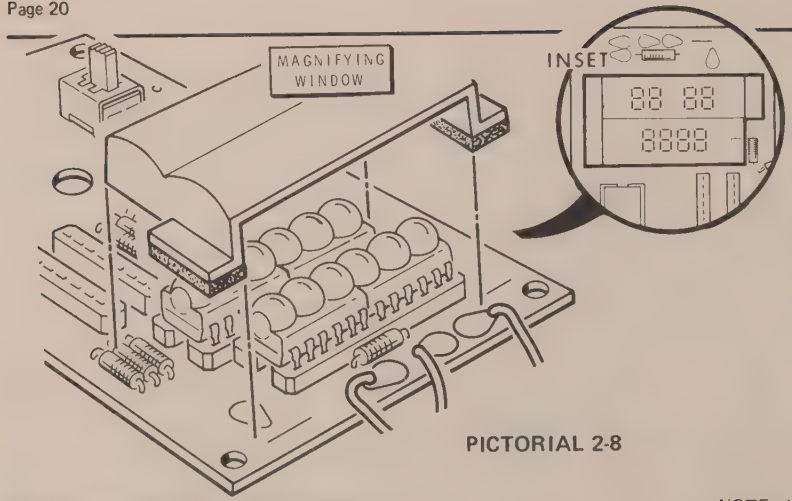
( ) "Cold" solder connections.

( ) Solder bridges between foils. See Page 16.

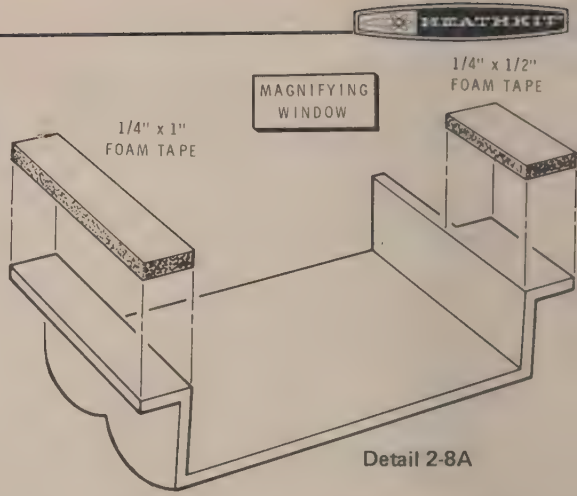
( ) Protruding leads which could touch together.

( ) Integrated circuit for the proper type and installation.

( ) LED's for proper installation.



PICTORIAL 2-8



Detail 2-8A

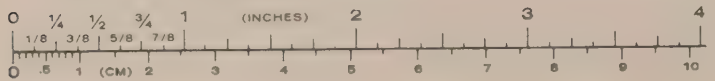
Refer to Pictorial 2-8 for the following steps.

( ) Wipe the LED's with a soft cloth to remove dust and fingerprints.

( ) Locate the magnifying window and the length of foam tape.

( ) Cut off two pieces of foam tape, one 1/4" x 1" and 1/4" x 1/2".

( ) Carefully wipe both sides of the magnifying window with a soft cloth to remove dust and fingerprints.



NOTE: In the following steps, handle the magnifying window by its sides to avoid getting fingerprints on the magnifying surface.

( ) Peel the protective backing from one side of the 1/4" x 1/2" piece of foam tape. Then refer to Detail 2-8A and press this side of the tape onto the bottom of the short flange of the magnifying window as shown.

( ) Peel the protective backing from one side of the 1/4" x 1" piece of foam tape. Then refer to the Detail again and press this side of the tape onto the long flange as shown.

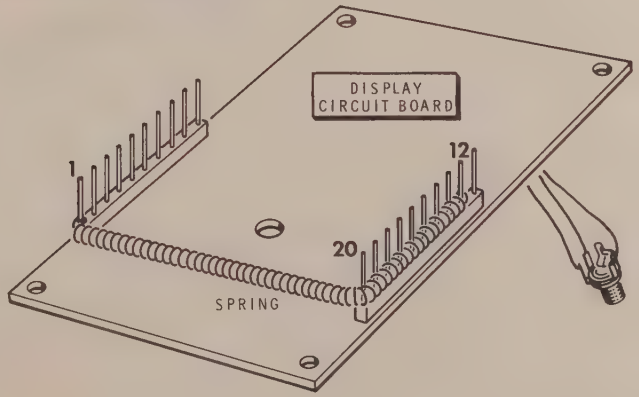
( ) Peel the remaining protective backing from both pieces of tape. Then center the magnifying window over the LED's on the display circuit board as shown in the inset drawing and press the window down on the circuit board.

DISPLAY CIRCUIT BOARD TESTING

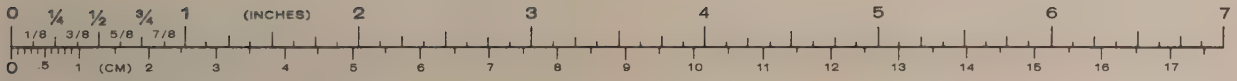
Refer to Pictorial 3-1 for the following steps.

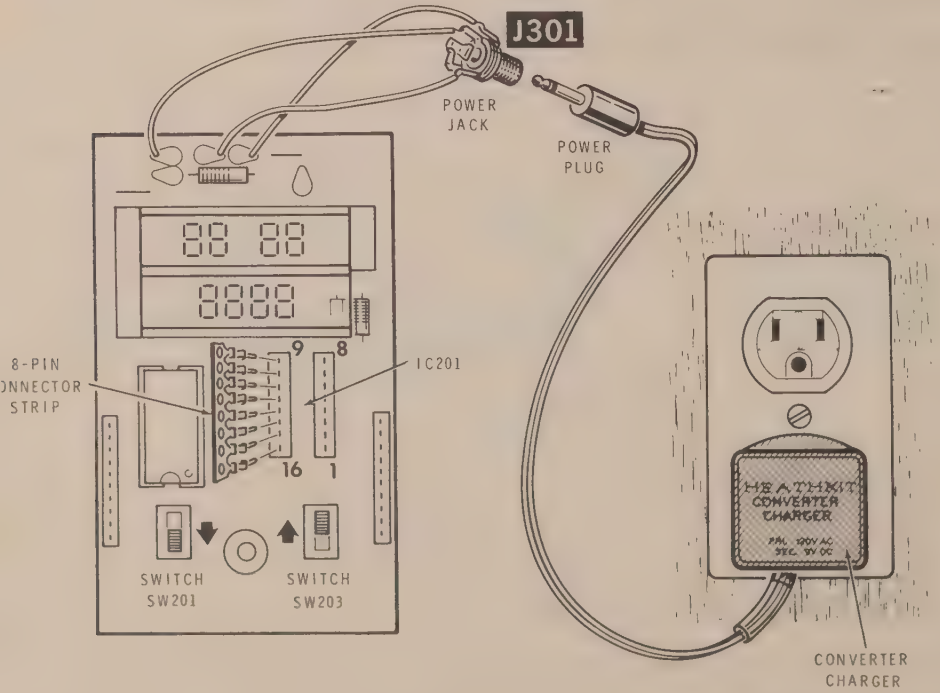
( ) Locate the expansion spring.

( ) Position the display circuit board as shown. Hook one end of the spring over circuit board plug pin 12. Then stretch the spring along pins 13 through 20 and across the board, and hook the other end of the spring over pin 1. Make sure the expansion spring is touching pins 12 through 20.

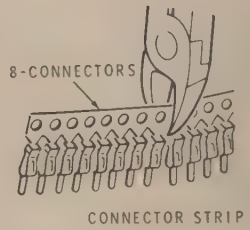


PICTORIAL 3-1





PICTORIAL 3-2



Detail 3-2A

Refer to Pictorial 3-2 for the following steps.

( ) Locate the strip of 12 IC connectors.

( ) Refer to Detail 3-2A and cut a strip of eight IC connectors. Do not separate the individual connectors from the strip. Set the remaining four connectors aside. They will be used later.

( ) Insert the strip of eight IC connectors in IC201 socket pins 9 through 16 as shown.

( ) Make sure slide switch SW201 is in the down position.

( ) Make sure slide switch SW203 is in the up position.

( ) Make sure the display circuit board is on a nonconductive surface.

( ) Plug the power plug of the Converter Charger into jack J301. Then plug the other end of the Converter Charger into an AC outlet.

NOTE: Keep the following points in mind whenever you use the converter charger:

– Always connect the power plug to the power jack (J301) before you plug the converter charger into an AC outlet.

– Always unplug the converter charger from the AC outlet before you unplug the power plug from the power jack.

– Anytime the power plug is connected to the Stopwatch, the charger should also be plugged into an AC outlet. When the power plug is connected to the Stopwatch without the charger being plugged into an AC outlet, the display will be dim and the operation may become erratic.

Place slide switch SW201 in the up position. The LED's should display eight 8's.

- If so, proceed to the next step.
- If part of each 8 is not displayed, first make sure the spring is touching pins 12 through 20. Then proceed to "Segment Testing" on Page 24.
- If all of one or more 8's are not displayed, proceed to "Digit Testing" on Page 25.
- If part of only one 8 is not displayed, place switch SW201 in the down position. Then substitute the problem LED with one that is working and repeat the step. If the same part of the 8 is still not displayed, a problem exists in the socket or its wiring (including the circuit board foils). However, if an 8 is now displayed at the location of the previous problem, the replaced LED was improperly installed or defective.

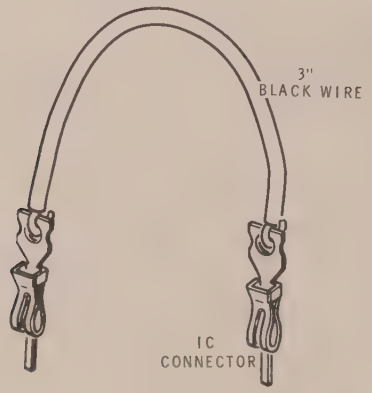
( ) Place slide switch SW201 in the down position.

( ) Unplug the Converter Charger from the AC outlet. Then unplug the power plug from jack J301.

( ) Remove the IC connector strip from IC201 socket.

( ) Remove the expansion spring from the circuit board plug pins.

Proceed to "IC Installation" on Page 27.



Detail 3-3A

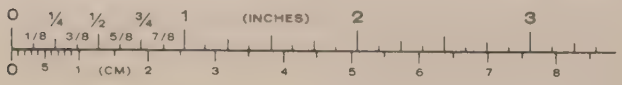
SEGMENT TESTING

Refer to Pictorial 3-3 (in the "Illustration Booklet") for the following steps.

( ) Place slide switch SW201 in the down position.

( ) Remove the IC connector strip from socket IC201.

( ) Prepare a 3" black wire.



( ) Cut off two single IC connectors from the four extra ones.

( ) Refer to Detail 3-3A and solder an IC connector to each end of the 3" black wire.

( ) Insert one IC connector on the test lead you assembled into socket IC201 pin 16.

( ) Make sure the spring is still installed as explained on Page 21.

( ) Place switch SW201 in the up position.

( ) Determine which segment is the problem segment. Then refer to the inset drawing on Pictorial 3-3 to see which pin of socket IC201 controls that segment.

( ) Insert the IC connector on the free end of the test lead into the pin of socket IC201 that controls the problem segment.

( ) If that segment of all eight 8's is still not displayed, recheck the display circuit board for solder bridges or broken foils.

( ) Place switch SW201 in the down position.

( ) Unplug the Converter Charger from the AC outlet. Then unplug the power plug from jack J301.

( ) Remove the expansion spring from the circuit board plug pins.

Proceed to "IC Installation" on Page 27.

DIGIT TESTING

Refer to Pictorial 3-4 (in the Illustration Booklet) for the following steps.

( ) Place slide switch SW201 in the down position.

( ) Make sure the strip of eight IC connectors is still installed in holes 9 through 16 of the socket at IC201.

( ) Remove the expansion spring from the circuit board plug pins.

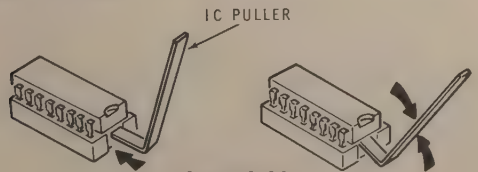
( ) Prepare a 3" black wire.

( ) Cut off two single IC connectors from the four extra ones.

NOTE: If you have not assembled a test lead, refer back to Detail 3-3A (on Page 24) for the following step.

( ) Solder an IC connector to each end of the 3" black wire.

( ) Refer to Detail 3-4A and use the IC puller to remove IC202 from its socket. Slide the puller under one end of the IC and rock the puller back and fourth to lift the IC.



Detail 3-4A

( ) Insert one IC connector on the test lead you assembled into socket IC202 pin 9.

( ) Place switch SW201 in the up position.

( ) Determine which digit is the problem. Then refer to the inset drawing on Pictorial 3-4 to see which pin of socket IC202 controls that digit.

( ) Insert the IC connector on the free end of the test lead into the pin of socket IC202 that controls the problem digit.

( ) If the problem digit does not display an 8, recheck the display circuit board for solder bridges or broken foils. If the problem digit does display an 8, replace IC202 with a new one.

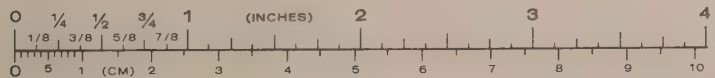
( ) Place switch SW201 in the down position.

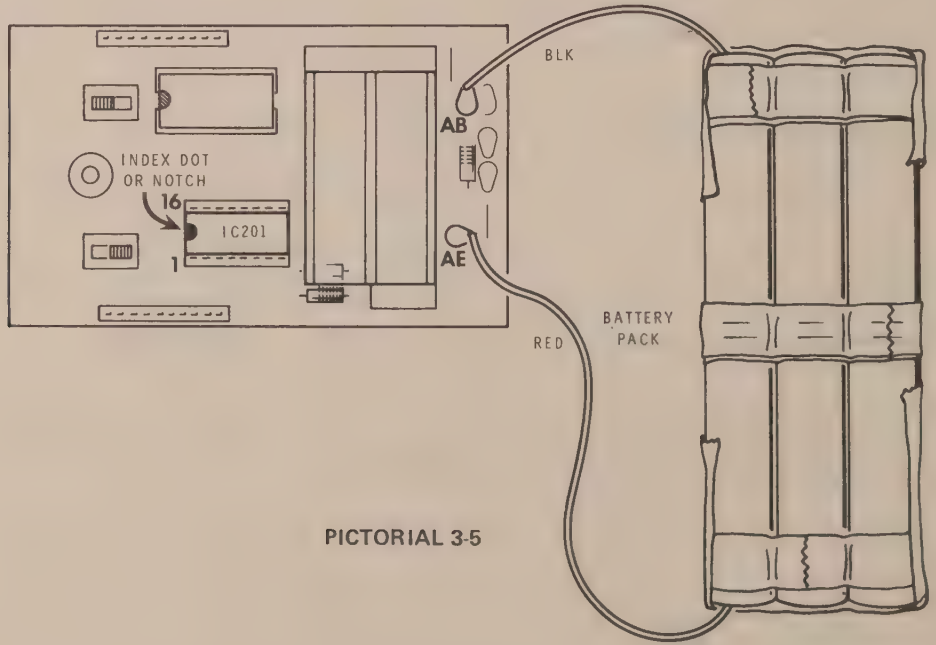
( ) Remove the IC connector strip from socket IC201.

( ) Unplug the Converter Charger from the AC outlet. Then unplug the power plug from jack J301.

( ) Reinstall IC202. Make sure the pin 1 end of the IC is aligned with the marked end of the outline on the display circuit board.

Proceed to "IC Installation."





PICTORIAL 3-5

IC INSTALLATION

Refer to Pictorial 3-5 for the following steps.

NOTE: The integrated circuit that you will install in the next step is a rugged and reliable component. However, normal static electricity discharged from your body, through an integrated circuit pin, to an object can damage the integrated circuit. Read the following four instructions first. Then carefully perform each step without interruptions.

1. Remove the IC from its package, with both hands.

2. Hold the IC in one hand, remove the conductive foam, and straighten any bent pins with the other hand.

3. Continue holding the IC, being careful not to touch it to anything. While you pick up and hold the circuit board in your other hand.

4. Align the pin 1 end of the IC (indicated by an indentation or dot) with socket pin 1. Carefully start the IC pins into the sockets; then push the IC down into the sockets. Once the IC's are inserted into the sockets they are protected against static electricity.

( ) IC201: Install an MM14511, 16-pin integrated circuit (#443-699) in socket IC201 as shown.

( ) Remove the tape from the free ends of the battery pack wires.

( ) Connect the black wire coming from the battery pack to display circuit board hole AB (S-1).

( ) Connect the red wire coming from the battery pack to display circuit board hole AE (S-1).

( ) Plug the power plug on the Converter Charger in jack J301; then set the display circuit board aside. Plug the Converter Charger into an AC outlet and let the batteries start to charge. NOTE: Switch SW201 (POWER) need not be turned on to charge the batteries.

This completes the "Display Circuit Board Testing." Proceed to "Main Circuit Board Assembly."

MAIN CIRCUIT BOARD ASSEMBLY

START

( ) Position the main circuit board as shown.

NOTE: When you install a diode, always match the band on the diode with the band mark on the circuit board. A DIODE WILL NOT WORK IF IT IS INSTALLED BACKWARDS. See Detail 4-1A.

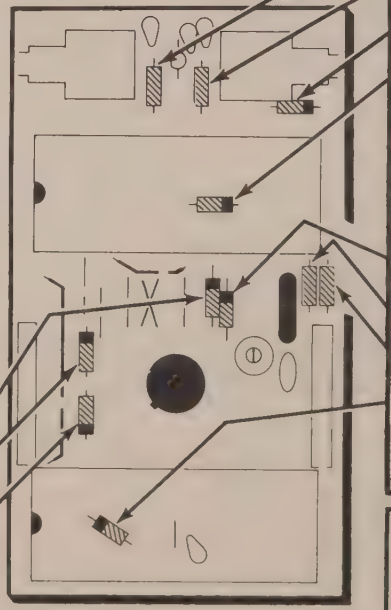
NOTE: Make sure you insert the next two diodes in the indicated holes.

( ) D101: 1N4149 diode (#56-56).

( ) D105: 1N4149 diode (#56-56).

( ) D103: 1N4149 diode (#56-56).

( ) Turn the circuit board over and solder the leads to the foil. Then cut off the excess lead lengths.



PICTORIAL 4-1

CONTINUE

( ) R103: 100 kΩ (brown-black-yellow).

( ) R104: 100 kΩ (brown-black-yellow).

( ) D109: 1N4149 diode (#56-56).

( ) D106: 1N4149 diode (#56-56).

NOTE: Make sure you insert the next diode in the indicated holes.

( ) D104: 1N4149 diode (#56-56).

( ) R101: 100 kΩ (brown-black-yellow).

( ) R102: 10 MΩ (brown-black-blue).

( ) D102: 1N4149 diode (#56-56).

( ) Turn the circuit board over and solder the leads to the foil. Then cut off the excess lead lengths.

IMPORTANT: THE BANDED END OF DIODES CAN BE MARKED IN A NUMBER OF WAYS.

Detail 4-1A

START

NOTE: When a jumper wire is called for, cut the white wire to the indicated length. Then remove 1/4" of insulation from each end and install the wire.

( ) 3/4" jumper wire.

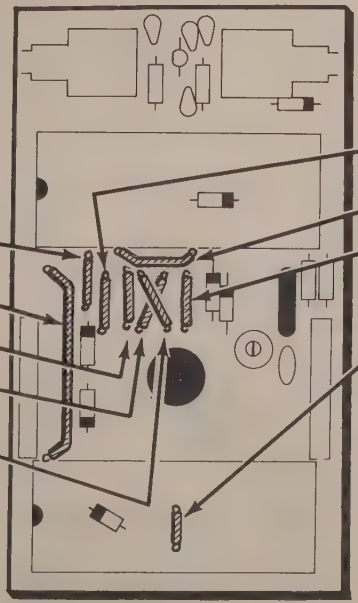
( ) 1-3/4" jumper wire.

( ) 3/4" jumper wire.

( ) 3/4" jumper wire.

( ) 3/4" jumper wire.

( ) Turn the circuit board over and solder the leads to the foil. Then cut off the excess lead lengths.



CONTINUE

( ) 3/4" jumper wire.

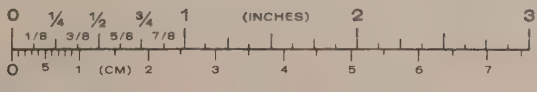
( ) 1" jumper wire.

( ) 3/4" jumper wire.

( ) 5/8" jumper wire.

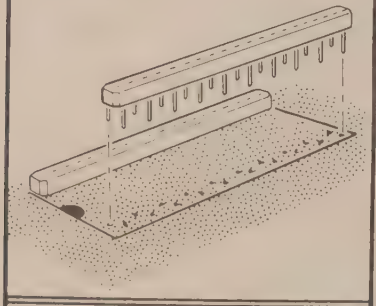
( ) Turn the circuit board over and solder the leads to the foil. Then cut off the excess lead lengths.

PICTORIAL 4-2



START

NOTE: To install the 20-pin IC socket, insert the pins and solder them to the foil. Make sure the socket is not tilted and is flush against the circuit board before you solder the pins.

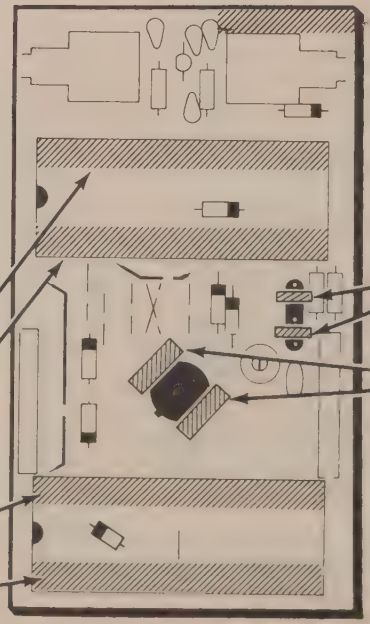


( ) 20-pin IC socket at IC101.

( ) 20-pin IC socket at IC101.

( ) 20-pin IC socket at IC102.

( ) 20-pin IC socket at IC102.



PICTORIAL 4-3

CONTINUE

( ) Locate the set of labels.

( ) Remove two of the small rectangular strips. Press the strips onto the circuit board at Y101. Position them close to, but not covering the circuit board holes.

( ) Likewise, press two small rectangular strips onto the circuit board at SW101.

( ) Cut a 1" x 1/8" strip from an unused part of the set of labels.

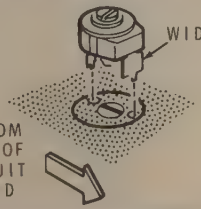
( ) Refer to the letters "SW-103" in the upper right corner of the circuit board. Then note the foil, along the top of the board, under this lettering.

( ) Remove the paper backing from the 1" x 1/8" strip of label and press the label strip onto the circuit board so it covers this strip of foil. The switch outline should still be visible after it is pressed down.

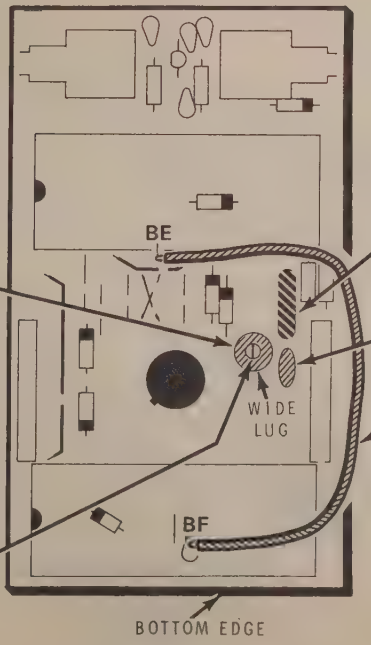
START

NOTE: When you install components in the following steps, turn the circuit board over and solder their lugs or leads to the foil as you install each component. Cut off the excess lead lengths.

( ) C101: 3.2–1.8 pF trimmer capacitor (#31-71). Carefully examine the lugs of the trimmer capacitor and notice that one lug may be wider than the other. If so, install the trimmer so this wide lug is toward the bottom edge of the circuit board. This will keep the wide lug from shorting across the two foils near the top hole.



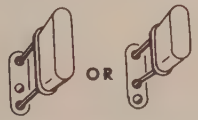
( ) Using a small screwdriver, turn the trimmer shaft so the slot is positioned as shown.



PICTORIAL 4-4

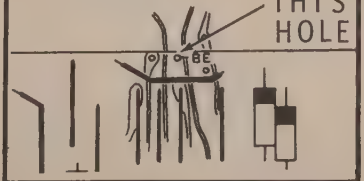
CONTINUE

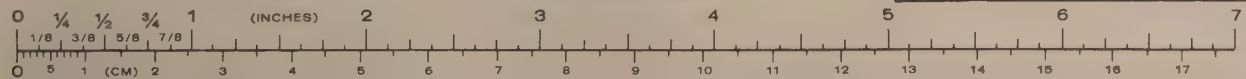
( ) Y101: Crystal (#404-572). This crystal may be supplied in either of two sizes. Always insert one lead into the hole nearest the top of the circuit board. Then insert the other lead into the appropriate bottom hole.

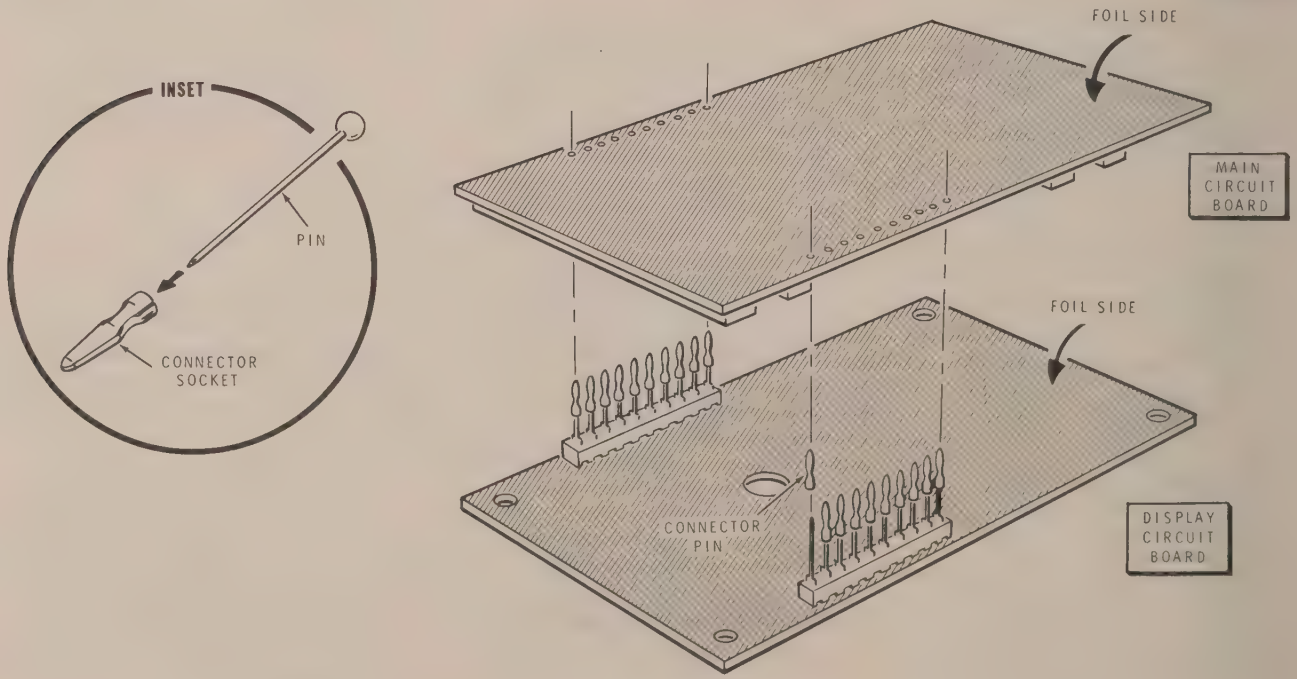


( ) C102: 47 pF ceramic capacitor.

( ) 4-1/2" white wire from hole BE to hole BF. Position this wire along the edge of the circuit board as shown. Make sure you use the hole to the left of the lettering "BE," and not the hole below it.







PICTORIAL 4-5

Refer to Pictorial 4-5 for the following steps.

( ) Locate 20 connector sockets and the pin.

( ) Refer to the inset drawing on the Pictorial and insert the pin into one of the connector sockets. Work the pin in and out of the socket several times to slightly open the connector.

( ) Use the pin to slightly open the remaining 19 connector sockets in the same manner.

NOTE: In the following steps, you will use the display circuit board as a fixture to install connector sockets on the main circuit board.

( ) Unplug the Converter Charger, first from the AC outlet and then from jack J301.

( ) Position the display circuit board as shown. Then install a connector socket on each circuit board plug pin on the display circuit board. Push each socket onto the pin as far as it will go. NOTE: There are two extra connector sockets. These will be used later.

( ) Position the main circuit board foil side up. Then lower the board until the connector sockets fit into their respective holes as shown. Gently press the two circuit boards together until the connectors are seated in the holes as far as they will go.

NOTE: The insulated jumper wire from hole BE to hole BF is positioned along these connectors. Be careful not to melt the insulation of this wire in the next step.

( ) Now solder each connector socket to the foil on the foil side of the main circuit board.

( ) After the solder connections have cooled, grasp each circuit board and pull them apart. Use a gentle rocking motion as you pull these boards apart.

( ) Again, plug the Converter Charger into jack J301 on the display circuit board. Set the display circuit board and battery pack aside, plug the Converter Charger into an AC outlet, and let the batteries continue to charge while you finish assembling the main circuit board.

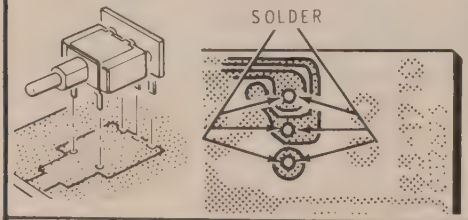
START

( ) Prepare one 1-1/2" red wire, two 1-1/2" white wires, and one 1-1/2" black wire.

NOTE: Only one end of each wire will be connected in the following steps.

( ) Insert and hold one end of a 1-1/2" red wire in hole BB, but do not solder it. NOTE: One of the lugs of the pushbutton switch you will install in the next step will also share hole BB.

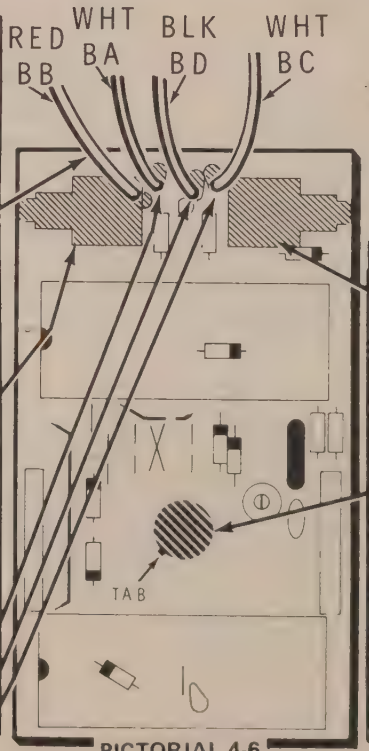
( ) SW102: Square pushbutton switch (#64-785). Make sure the switch is "seated" flat against the circuit board. Then turn the circuit board over and solder the lugs and the red wire to the foil as shown.



( ) 1-1/2" white wire to hole BA (S-1)

( ) 1-1/2" black wire to hole BD (S-1).

( ) 1-1/2" white wire to hole BC (S-1).

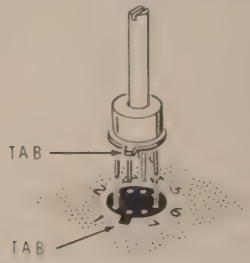


PICTORIAL 4-6

CONTINUE

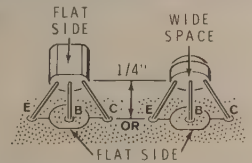
( ) SW103: Square pushbutton switch (#64-785). Solder the lugs to the foil.

( ) SW101: Rotary switch (#63-1256). Line up the tab on the switch with the outline of the tab on the circuit board. Then insert the switch pins into their respective holes, turn the circuit board over, and solder them to the foil. Cut off the excess pin lengths.



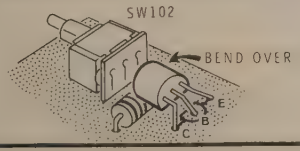
START

NOTE: The following transistor may be either one of the two types shown below. Determine which type you received and insert the transistor leads into corresponding E, B, and C holes in the circuit board as shown. Then solder the leads to the foil and cut off the excess lead lengths.



( ) Q101: 2N4121 transistor (#417-235).

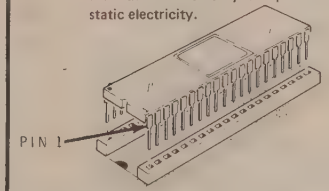
( ) Bend the transistor over toward SW102 as shown.

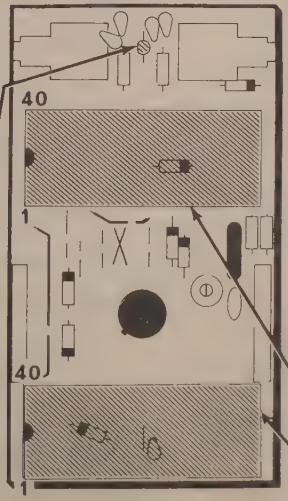


CONTINUE

NOTE: The integrated circuits that you will install in the next steps are rugged and reliable components. However, normal static electricity discharged from your body, through an integrated circuit pin, to an object can damage the integrated circuits. Read the instruction first. Then carefully perform each step without interruption.

1. Remove the IC from its package, with both hands.
2. Hold the IC in one hand, remove the conductive foam, and straighten any bent pins with the other hand.
3. Continue holding the IC, being careful not to touch it to anything, while you pick up and hold the circuit board in your other hand.
4. Align the pin 1 end of the IC (indicated by a 1) with socket pin 1. Carefully start the IC pins into the sockets; then push the IC down into the sockets. Once the IC's are inserted into the sockets they are protected against static electricity.



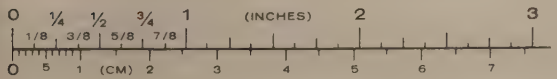


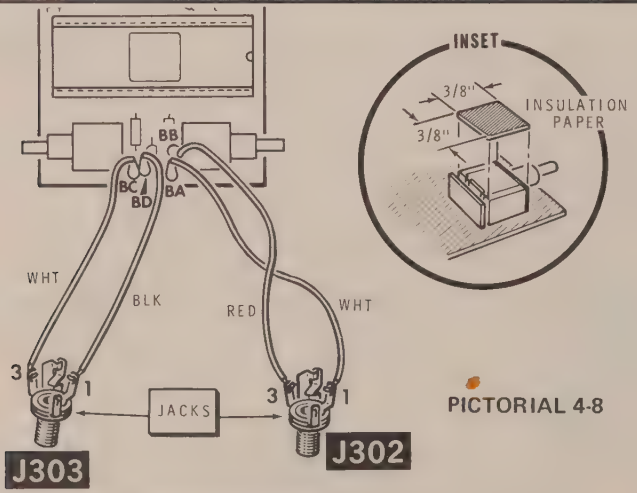
PICTORIAL 4-7

( ) IC101: Program event integrated circuit (#443-693).

( ) IC102: Program event integrated circuit (#443-693).

Save the conductive foam to hold the integrated circuits if they must be removed later. Do not use this conductive foam for any other purpose.





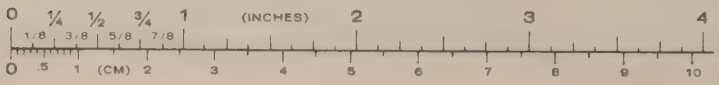
PICTORIAL 4-8

Refer to Pictorial 4-8 for the following steps.

( ) Cut out two 3/8" x 3/8" squares of insulating paper.

( ) Remove the backing paper from one of the squares of insulating paper. Then press the square onto switch SW102 as shown in the inset drawing.

( ) Likewise, remove the backing paper and press the other square of insulating paper onto switch SW103.



( ) Position the main circuit board as shown.

( ) Locate the two remaining phone jacks. Save the nuts, but discard the flat washers. These jacks will become input jacks J302 and J303.

Connect the wires coming from the main circuit board to these two jacks as follows:

( ) White wire coming from hole BA to J302 lug 1 (S-1).

( ) Red wire coming from hole BB to J302 lug 3 (S-1).

( ) White wire coming from hole BC to J303 lug 3 (S-1).

( ) Black wire coming from hole BD to J303 lug 1 (S-1).

CIRCUIT BOARD CHECKOUT

Carefully inspect the circuit board for the following conditions.

( ) Unsoldered connections.

( ) "Cold" solder connections.

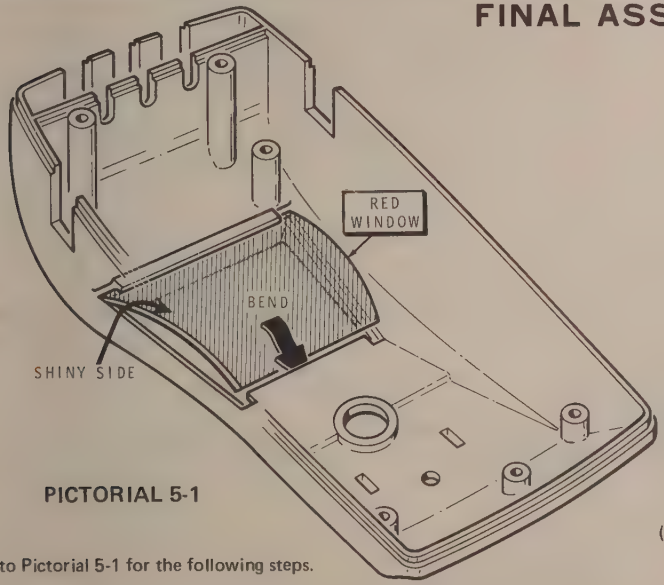
( ) Solder bridges between foils. See Page 16.

( ) Protruding leads which could touch together.

( ) Integrated circuits, transistors, and diodes for the proper type and installation.

This completes the assembly of the main circuit board. Proceed to the "Final Assembly" Section.

FINAL ASSEMBLY



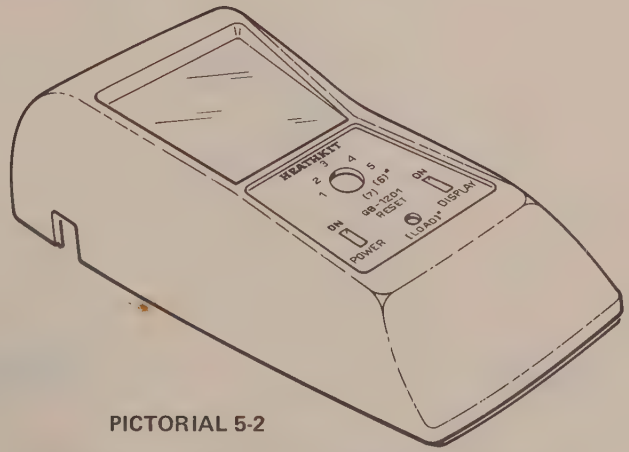
PICTORIAL 5-1

Refer to Pictorial 5-1 for the following steps.

( ) Locate the cabinet top, the red window, and the set of labels.

( ) Peel away the protective film and/or paper from both sides of the window and wipe the window with a soft cloth.

NOTE: One side of the window is shiny and the other side is dull. Be sure to position the shiny side of the window toward the inside of the cabinet in the next step.

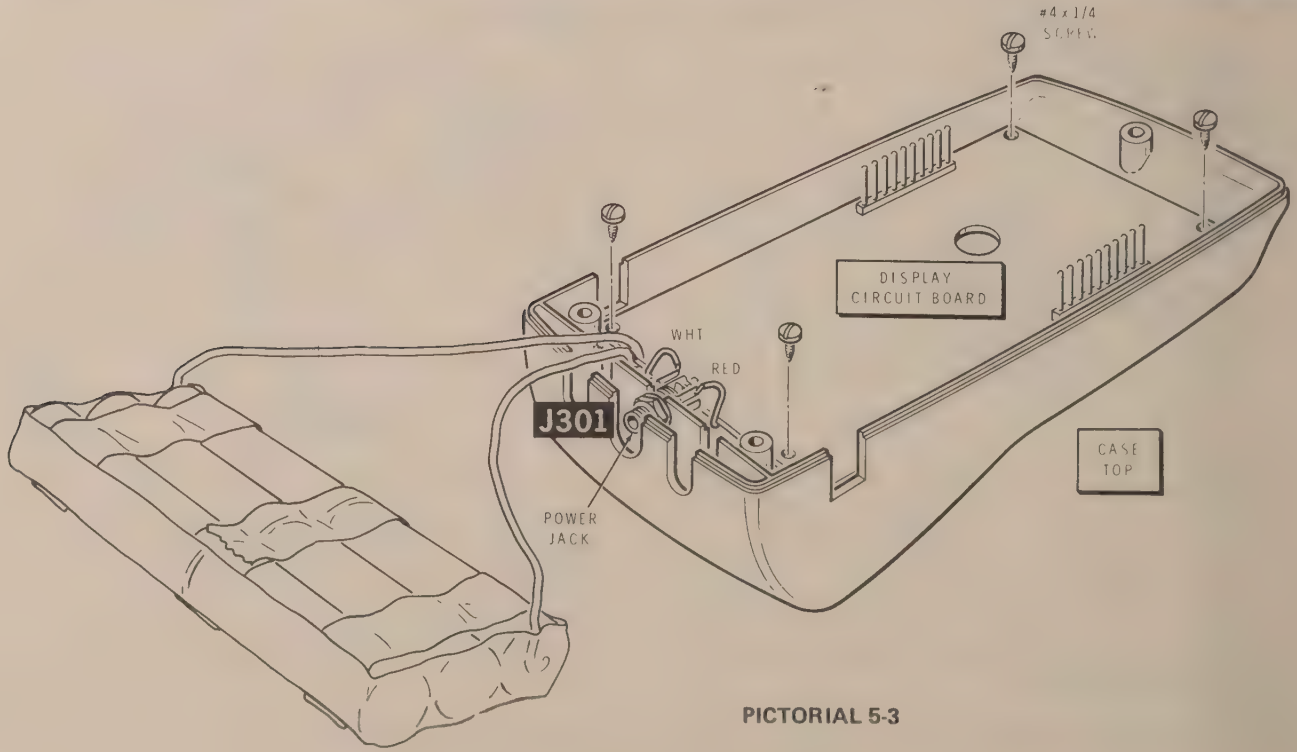


PICTORIAL 5-2

( ) Position the cabinet top as shown. Slide the top of the red window into the slot as shown. Then lower the bottom of the window and snap it in place.

Refer to Pictorial 5-2 for the following steps.

( ) Peel the function label from the set of labels. Then press it in position on the cabinet top as shown.



PICTORIAL 5-3

Refer to Pictorial 5-3 for the following steps.

( ) Unplug the Converter Charger, first from the AC outlet and then from jack J301.

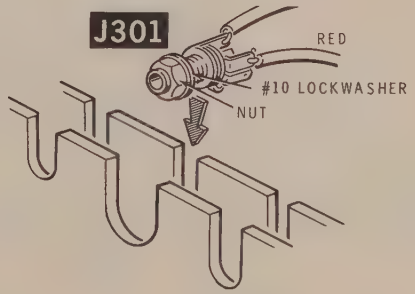
( ) Position the cabinet top as shown. Then place the battery pack and display circuit board near the cabinet top.

( ) Make sure fuse wires F1 and F2 on the display circuit board are still intact. Then lower the circuit board down into the cabinet top. Position the battery pack wires as shown.

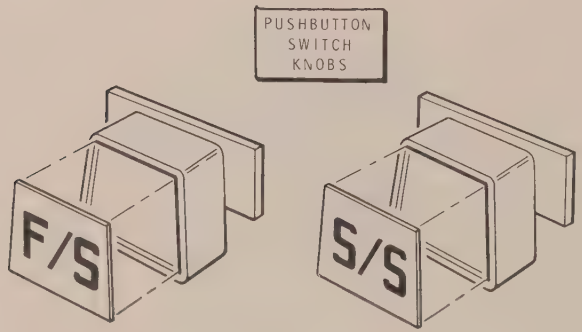
( ) Mount the display circuit board to the cabinet top with #4 x 1/4" screws as shown. Be careful not to overtighten the screws.

( ) Refer to Detail 5-3A and start a #10 lockwasher and nut on jack J301.

( ) Position jack J301 exactly as it is shown in the Detail. Then slide the jack in the center slot of the cabinet top as far as it will go. Make sure the #10 lockwasher is between the nut and cabinet top. Tighten the nut using a pair of long-nose pliers. Do not let the jack turn.



Detail 5-3A



Detail 5-4B

Refer to Pictorial 5-4 (in the "Illustration Booklet") for the following steps.

( ) Position the main circuit board near the cabinet top as shown.

( ) Refer to Detail 5-4A and start a #10 lockwasher and a nut on each of jacks J302 and J303.

( ) Position jack J302 exactly as it is shown in the Detail. Then slide it into the indicated slot of the cabinet top as far as it will go. Make sure the #10 lockwasher is between the nut and the cabinet top. Tighten the nut using a pair of long-nose pliers. Do not let the jack turn.

( ) In the same manner, install jack J303 in the remaining slot.

( ) Locate two square pushbutton switch knobs and two compression springs.

( ) Peel the F/S label from the set of labels. Then refer to Detail 5-4B and press the label in position on one of the square pushbutton switch knobs. Note that the label and the depression in the knob are tapered. The label will only fit in one position.

( ) In the same manner, peel the S/S label from the set of labels and install it on the remaining square pushbutton switch knob.

NOTES:

1. In the following steps you must make a choice between the lighter compression springs and the heavier compression springs. The lighter compression springs will make the S/S and F/S pushbuttons easier to push. The heavier compression springs are better if there is a possibility that you may use the Stopwatch in an application where the S/S and F/S pushbuttons can be acidentally pushed or bumped.

2. In the next two steps, install the knobs and springs so the letters read as shown in the Pictorial.

( ) Install a compression spring and the F/S knob on square pushbutton switch SW103. Hold it in place.

( ) Install a compression spring and the S/S knob on square pushbutton switch SW102. Hold it in place.

( ) Make sure that rotary switch SW101 on the main circuit board is in the fully counterclockwise position. See the inset drawing on Detail 5-4C.

NOTE: The following steps are difficult. Take your time and perform each step as instructed.

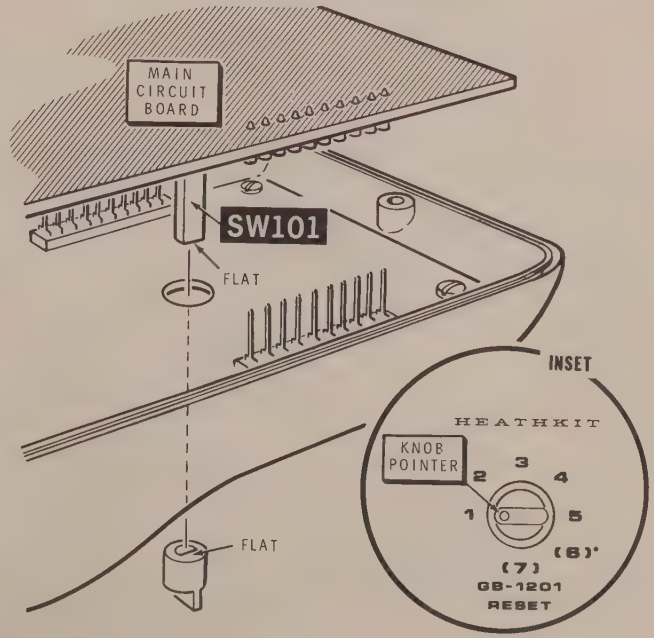
In the following steps, refer to Detail 5-4C and install the main circuit board so that:

- The F/S and S/S switch knobs slide in the slots in the sides of the cabinet top.
- The plug connectors on the main circuit board fit in their respective circuit board plug pins on the display circuit board.
- The shaft of rotary switch SW101 goes through the hole in the display circuit board.

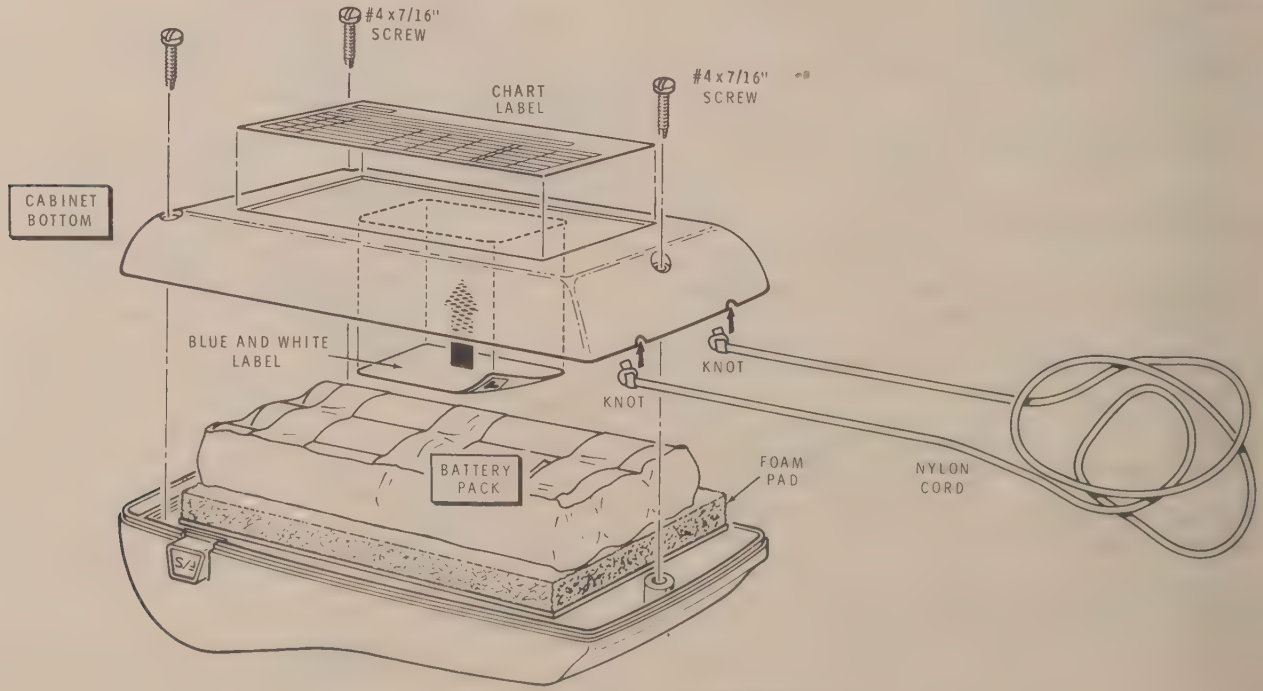
( ) Position the main circuit board as shown and depress both S/S switch SW102 and F/S switch SW103. Lower the board into the cabinet top.

( ) Double check the plug connector to plug pin alignment and gently press the main circuit board down as far as it will go.

( ) Line up the flat on the rotary switch shaft with the flat in the rotary switch knob. Then push the knob on the shaft as far as it will go. See Detail 5-4C.



Detail 5-4C



PICTORIAL 5-5

Refer to Pictorial 5-5 for the following steps.

( ) Cut the foam pad to 2-1/4" x 4".

( ) Place the foam pad on the main circuit board.

( ) Place the battery pack on the foam pad as shown.

( ) Peel the chart label from the set of labels and press it in position on the outside of the cabinet bottom as shown.

( ) Remove the backing paper from the blue and white label. Press the label onto the inside of the cabinet bottom. Be sure to refer to the numbers on this label in any communications you might have with the Heath Company about this kit.

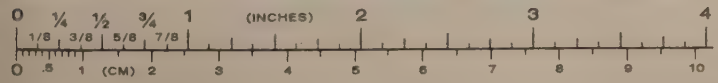
( ) Locate the cabinet strap and tie a knot in each end as shown. NOTE: You may find that the strap is longer than you desire. If so, cut it to the desired length.

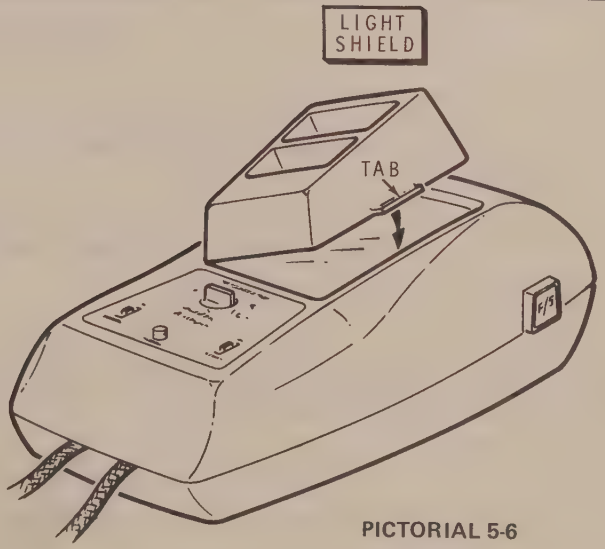
( ) Slide these knots into the slots as shown.

( ) Position the cabinet bottom on the cabinet top and fasten them together with three #4 x 7/16" screws. Make sure the pushbutton switches do not bind.

Refer to Pictorial 5-6.

When the light shield is installed on your Stopwatch, it shades the displays and





PICTORIAL 5-6

makes them easier to see, especially when you use the Stopwatch out-of-doors in bright sunlight. Use your Stopwatch with or without the light shield as you desire.

Gently squeeze the sides of the light shield, just above the tabs, whenever you install or remove it.

This completes the "Final Assembly." Proceed to the "Operational Tests" section.

OPERATIONAL TESTS

The purpose of this section of the Manual is to make sure your Deluxe Digital Stopwatch operates properly and will not be damaged as a result of a wiring error. A transistor or integrated circuit, for example, could be destroyed instantly by a short circuit that causes excessive current.

NOTE: If you have any trouble in the following steps, place the POWER switch in the OFF position and refer to the "In Case of Difficulty" section on Page 68.

Refer to Figure 1-1 (on Page 51) for the following steps.

NOTE: You will test each function of your Stopwatch in the following steps. Once you have started a function test, complete it without interruption. When you are told to wait a length of time after you press the S/S switch, start measuring the time as soon as you press the switch.

FUNCTION 1

( ) Turn the FUNCTION switch (SW101) to the FUNCTION 1 position.

( ) Push the POWER switch (SW201) to the ON position.

( ) Push the DISPLAY switch (SW203) to the ON position.

( ) Press the RESET switch (SW202). The display should be blank.

NOTE: Read the remainder of this FUNCTION 1 test steps before you proceed.

( ) Press the S/S switch (Start-Stop; SW102). The display should start counting.

( ) Let the display count to approximately 5.00 seconds. Then press the S/S switch. The display should stop counting.

( ) Wait approximately 5 seconds. Then press the S/S switch. The display should start counting again from zero.

( ) Let the display count to approximately 5.00 seconds. Then press the F/S switch (Final-Stop; SW103). The display should stop counting.

( ) Now press the S/S switch. The display should show approximately 15.00 seconds.

FUNCTION 2

( ) Turn the FUNCTION switch to the FUNCTION 2 position.

( ) Press the RESET switch. The display should be blank.

NOTE: Read the remainder of the FUNCTION 2 test steps before you proceed.

( ) Press the S/S switch. The display should start counting.

( ) Let the display count to approximately 5.00 seconds. Then press the S/S switch. The display should stop counting.

( ) Wait approximately 5 seconds. Then press the S/S switch. The display should read approximately 5.00 seconds.

( ) Immediately push the DISPLAY switch to the OFF position and then back to the ON position. Let the display continue to count to approximately 5.00 seconds; then press the F/S switch. The display should stop counting.

( ) Now press the S/S switch. The display should show approximately 15.00 seconds.

FUNCTION 3

( ) Turn the FUNCTION switch to the FUNCTION 3 position.

( ) Press the RESET switch. The display should be blank.

NOTE: Read the remainder of the Function 3 test steps before you proceed.

( ) Press the S/S switch. The display should start counting.

( ) Let the display count to approximately 5.00 seconds and then press the S/S switch. The display should stop counting.

( ) Wait approximately 5 seconds and then press the S/S switch. The display should start counting up from approximately 5.00.

( ) Let the display count to approximately 10.00 seconds and then press the F/S switch.

( ) Now press the S/S switch. The display should show approximately 15.00 seconds.

FUNCTION 4

( ) Turn the FUNCTION switch to the FUNCTION 4 position.

( ) Press the RESET switch. The display should be blank.

NOTE: Read the remainder of the Function 4 test steps before you proceed.

( ) Press the S/S switch. The display should start counting.

( ) Let the display count to approximately 5.00 seconds. Then press the S/S switch. The display should stop counting.

( ) Wait approximately 5 seconds. Then press the S/S switch. The display should show approximately 10.00 seconds.

( ) Wait approximately 5 seconds and then press the F/S switch. The display should show approximately 15.00 seconds.

( ) Now press the S/S switch. The display should show the same number.

FUNCTION 5

( ) Turn the FUNCTION switch to the FUNCTION 5 position.

( ) Press the RESET switch. The display should be blank.

NOTE: Read the remainder of the function 5 test steps before you proceed.

( ) Press the S/S switch. The display should start counting.

( ) Let the display count to approximately 5.00 seconds and then press the S/S switch. The display should stop counting.

( ) Wait approximately 5 seconds and then press the S/S switch. The display should start counting again.

( ) Let the display count to approximately 5.00 seconds and then press the F/S switch. The display should stop counting.

( ) Now press the S/S switch. The display should show approximately 10.00 seconds.

FUNCTIONS 6 and 7

( ) Turn the FUNCTION switch to the FUNCTION 7 position.

( ) Press the RESET switch.

( ) Press the F/S switch.

( ) Turn the FUNCTION switch to the FUNCTION 1 position.

( ) Press and hold the S/S switch.

( ) Press and hold the F/S switch. The hours digit should start counting.

( ) Release only the F/S switch.

( ) Turn the FUNCTION switch to the FUNCTION 2 position.

( ) Press and hold the F/S switch. (You should still be holding the S/S switch.) The tens of minutes digit should start counting.

( ) Release only the F/S switch.

( ) Turn the FUNCTION switch to the FUNCTION 3 position.

( ) Press and hold the F/S switch. The minutes digit should start counting.

( ) Release only the F/S switch.

( ) Turn the FUNCTION switch to the FUNCTION 4 position.

( ) Press and hold the F/S switch. The tens of seconds digit should start counting.

( ) Release only the F/S switch.

( ) Turn the FUNCTION switch to the FUNCTION 5 position.

( ) Press and hold the F/S switch. The seconds digit should start counting.

( ) Release both the S/S and F/S switch.

( ) Turn the FUNCTION switch to the FUNCTION 7 position.

( ) Press the RESET switch.

( ) Press the F/S switch.

( ) Turn the FUNCTION switch to the FUNCTION 5 position.

NOTE: The Stopwatch is now in its digit set mode. When you press and hold the S/S and F/S pushbutton in the next step the seconds digit will begin counting upward. The instant the desired number is displayed (in this case it is 5) you must immediately release both the S/S and F/S pushbuttons. If you wait too long or hesitate to release them, the display will count higher than you had desired. Also, since the display goes blank as soon as the pushbuttons are released, you must turn the FUNCTION switch to FUNCTION 6 (as explained in the second step) to see if the actual seconds digit you set is correct. If the seconds digit is incorrect, turn the FUNCTION switch back to FUNCTION 5 and again press both pushbuttons to reset the seconds digit.

( ) Press and hold the S/S and F/S switches. Let the seconds digit count to 5; then immediately release both the S/S and F/S switches.

( ) Turn the FUNCTION switch to the FUNCTION 6 position. A 5 should be displayed in the seconds digit.

( ) Press the LOAD (Reset) pushbutton.

( ) Press the S/S switch. The display should count up from 00 to 5.00 and then stop.

( ) Press the LOAD (Reset) pushbutton.

( ) Again press the S/S switch. The display should again count up from 00 to 5.00 and then stop.

( ) Press the LOAD (Reset) pushbutton.

( ) Turn the FUNCTION switch to the FUNCTION 7 position.

( ) Wait approximately 10 seconds and then press the S/S switch. The display should count down from 5.00 to 00 and stop.

( ) Push the POWER switch to the OFF position.

This completes the Operational Tests. Proceed to "Operation" on Page 48.

OPERATION

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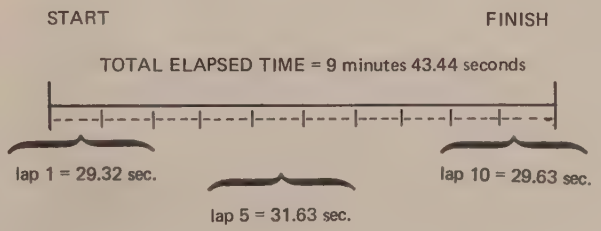
Introduction

Your Deluxe Digital Stopwatch is essentially seven instruments in one. Two of its sophisticated functions (6 & 7) provide an up-count and a down-count capability. The other five functions (1-5) use two counters simultaneously to time two separate, but related, time intervals. These counters are referred to in this section of the Manual and on the operation label (on the back of the Stopwatch) as counter A and counter B.

Each of the seven functions has its own specific operating sequence or procedure. However, functions 1 through 5 have four basic operational steps in common:

- Both counters A and B start simultaneously when you press the S/S (Start-Stop) pushbutton the first time.
- Counter A contents are displayed when you press the S/S pushbutton the second time.
- Both counter A and B stop when you press F/S (Final-Stop) the first time.
- Further timing of the same event cannot resume once you have pressed F/S.

The terms, or expressions, "overall event" and "individual event" are used in this section to explain the operation of each function. An overall event refers to a race, a meet, a competition, a gymkhana, or any major occurance. An individual event refers to a lap, a leg, a round, an inning, a period, or any lesser occurance within the time of the overall event. The illustration below shows the total elapsed time of a race (overall event) and the elapsed times of several laps (individual events).



FAMILIARIZATION

Refer to Figure 1-1 as you read the following information.

1 Turn the POWER switch ON as you prepare to measure a time interval.

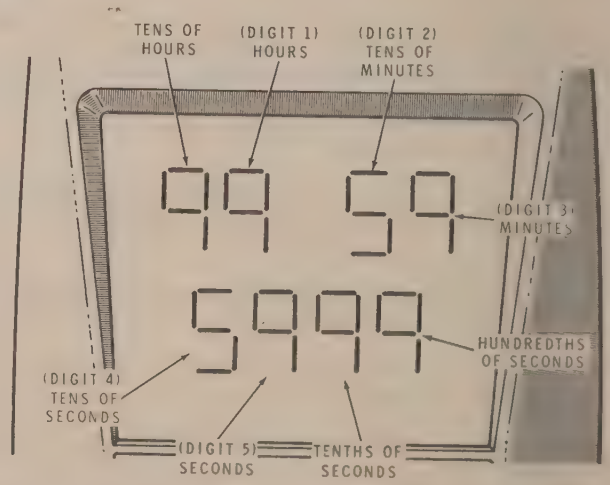
2 Push the RESET (LOAD) pushbutton to reset (clear) the Stopwatch counters for all functions except function 6. When you select 6, the RESET (LOAD) pushbutton enters (loads) the displayed number into the Stopwatch counters.

3 Press the S/S (START/STOP) pushbutton to start and stop the individual events counter. It also starts the overall events counter, but does not stop it.

4 Push the F/S (FINAL STOP) pushbutton at the end of the overall event to stop both the individual events counter and the overall events counter.

5 Turn the DISPLAY switch off to conserve battery power when you use functions 1 through 5. You can see the counting process for those functions (2 and 3) that do not normally display it after the third S/S entry, if you turn the DISPLAY switch off and back on. Do not turn the DISPLAY switch off when you use functions 6 or 7.

6 The elapsed time of an event is displayed as follows:



The five numbered digits (Digit 1 through Digit 5) are explained under "Function 6."

7 The FUNCTION switch selects one of seven timing functions. Each function is explained in detail later.

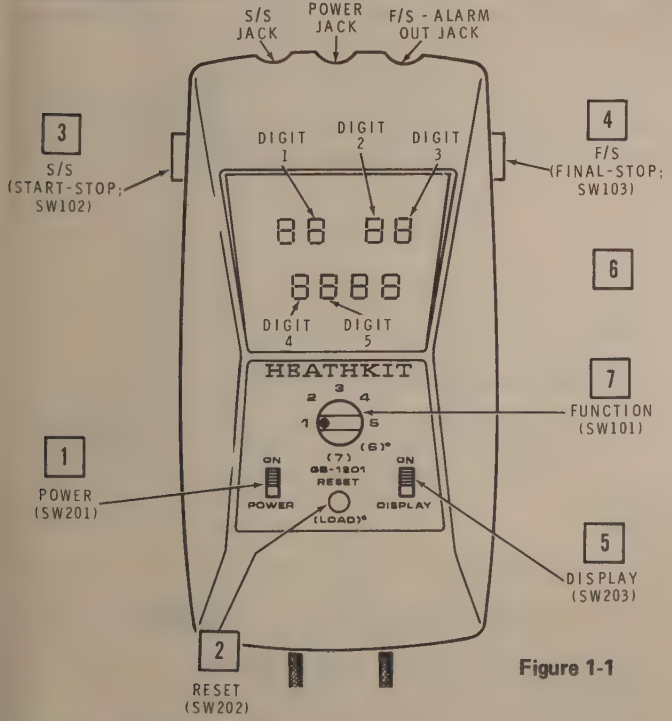


Figure 1-1

Notice that the S/S jack is nearest the S/S pushbutton, the F/S-Alarm Out jack is nearest the F/S pushbutton, and the Power jack is in the center.

BATTERY CHARGING

The Charger furnished with this kit supplies 9 volts DC at 100 milliamperes to operate the Stopwatch and to charge its batteries. Use the charger to power the Stopwatch whenever an AC power source is available. The batteries will supply power for approximately 4 hours of operation with the display lighted continuously and about 40 hours of operation with the display turned off most of the time.

Keep the following points in mind whenever you use the converter charger:

- Always connect the power plug to the power jack (J301) before you plug the converter charger into an AC outlet.
- Always unplug the converter charger from the AC outlet before you unplug the power plug from the power jack.
- Anytime the power plug is connected to the Stopwatch, the charger should also be plugged into an AC outlet. When the power plug is connected to the Stopwatch without the charger being plugged into an AC outlet, the display will be dim and the operation may become erratic.

It requires approximately 14 hours (with the Stopwatch turned off) to completely charge the batteries. The batteries will not overcharge if the charger is left on for longer periods of time. It is good, however, to operate the Stopwatch from time to time.

USING THE STOPWATCH

When each function is explained in detail, you will be instructed to place the Stopwatch in its "ready state." This means that the batteries should be charged sufficiently to provide power through the timing period. It also means to turn

the POWER switch on, to turn the DISPLAY switch on, and to press the RESET pushbutton. This turns the Stopwatch on, clears its counters, and makes it ready to begin a timing sequence.

Additionally, you can momentarily press the S/S pushbutton to verify and watch the counting process, to make sure the Stopwatch operates properly. Press the RESET pushbutton to return the Stopwatch to its "ready state."

A two-color operational label (on the bottom of the Stopwatch) uses an example to briefly explain functions 1 through 5. The example is divided into three parts: Interval 1 is a three minute interval; Interval 2 is a two minute interval; Interval 3 is a one minute interval. S/S (START/STOP) entries are made at the start and finish of Interval 1, at the start of Interval 2, and at the start of Interval 3. A F/S (FINAL STOP) entry is made at the conclusion of Interval 3. The example shows what occurs in both the Stopwatch counters for functions 1 through 5.

Even though your Deluxe Digital Stopwatch is very precise, you must start and stop it quickly and consistently to keep the slight human error, caused by your reaction time, to a minimum. A little practice will help you become skillful at operating your Stopwatch. If you need extreme accuracy, use one of the electronic triggering methods explained in the section "Optional Inputs and Outputs."

The internal sequencing of the MOS (metal oxide semiconductor) LSI (large scale integration) integrated circuits for functions 1 and 5 may occasionally cause the count in counter B (the total elapsed time counter) to be a maximum of .02 seconds (per event) greater than the count in counter A (the individual events counter). This is not significant for hand-held operation and it can be ignored. However, if you cannot tolerate this slight deviation when you use an electronic triggering method, use one of the other functions (2, 3, or 4).

Even though Operational examples are used to explain how each function operates, they do not represent the only application of each function. Once you become familiar with the Digital Stopwatch you will find many more possible applications and uses.

The LED displays in the Stopwatch are specifically designed for brightness. However, you may find that when you use the Stopwatch out-of-doors the displays may not seem as brightly lit. This is caused by the intense brightness of sunlight. Always use the light shield when you encounter this situation.

DO

- Keep the batteries charged.
- Place the Digital Stopwatch in its ready state before the events begins.
- Press F/S only at the end of the overall event.
- Handle the Digital Stopwatch carefully.
- Protect your Stopwatch from rain and excessively humid conditions. It is not waterproof and should be protected the same as you would protect any other precision instrument.

DO NOT

- Turn the POWER switch off while you are timing an event.
- Press the RESET pushbutton while you are timing an event.
- Turn the FUNCTION switch to another position while you are timing an event.
- Subject the Stopwatch to extreme and unnecessary temperature. Do not place it on the dashboard or in the rear window of your car as these areas often get extremely hot.

Function 1... Start/Stop - Total Elapsed Time

WHAT IT DOES –

1. Counter B measures the total elapsed time of an overall event.
   - It counts from the first S/S entry to the first F/S entry.
2. Counter A times individual events.
   - It counts initially from the first S/S entry to the second S/S entry.
   - Further S/S entries alternately clear counter A to zero and restart it counting; then stop the counting in counter A.

HOW TO USE IT –

TURN the FUNCTION switch to position 1.

PUSH the POWER switch to the ON position.

PUSH the DISPLAY switch to the ON position.

PUSH the RESET pushbutton. The display will be blank.

PRESS the S/S pushbutton at the beginning of the overall event. Do not press F/S until the overall event is finished.

PRESS S/S a second time (at the end of the first period, for example) to measure and display the elapsed time of an individual event (period). Counter A stops and displays the individual event time, but it does not effect the total elapsed time accumulating in counter B.

Further S/S entries alternately reset counter A to zero and restart it (at the beginning of another individual event); then stop counter A (at the end of the individual event).

PRESS F/S as the overall event ends. This entry stops both counter A and counter B. The time displayed is the time of counter A (the last individual event time).

PRESS S/S to display the total elapsed time of counter B. Further S/S entries alternate the display between the time in counter A (the last individual event time) and the time in counter B (the total elapsed time).

You can turn the DISPLAY switch off any time you wish. This will conserve battery power.

EXAMPLE #1

You want to time two runners competing in the 440 yard dash at the local track meet. Shortly before the race is scheduled to begin, check to make sure your Stopwatch is in its ready state. Then, as the starting gun sounds, press the S/S pushbutton. Press the S/S pushbutton again as the first runner (hopefully your favorite) crosses the finish line. Press the F/S pushbutton when the second runner crosses the finish line. The time displayed is that of the first runner. Press the S/S pushbutton again to display the time of the second runner.

EXAMPLE #2

Assume that you want to measure the cycling times of a machine to determine its operation. First, check to make sure your Stopwatch is in its ready state. Then press the S/S pushbutton again when the machine starts. Press S/S again when the machine stops. Record this "on" time. Press S/S each time the machine starts and each time it stops. Record each "on" time. Complete the measurement by pressing the F/S pushbutton as the machine just starts a new cycle (this is also the end of the last cycle). Record the final "on" time. Press the S/S pushbutton to display the total elapsed time of the test.

Divide the total elapsed time by the number of times the machine cycled to obtain the average cycle time. Add up the individual "on" times and divide the sum by the number of times the machine cycled to obtain the average "on" time. Divide the sum of the individual "on" times by the total elapsed time and multiply by one hundred (X100) to obtain the percentage of "on" time.

Function 2... Sequential-Total Elapsed Time

WHAT IT DOES –

1. Counter B measures the total elapsed time of an overall event.
   - It counts from the first S/S entry to the first F/S entry.
2. Counter A times individual events.
   - It counts initially from the first S/S entry to the second S/S entry, but also clears counter A to zero and restarts counting again at the second S/S entry. The display retains the previous contents of counter A.
   - The third and subsequent S/S entries only display the updated count and not the actual counting process.
   - Each additional S/S entry displays the new time elapsed in counter A (the time elapsed between S/S entries), clears counter A to zero, and restarts counting again.
   - Turn the DISPLAY switch off and back on to observe the counting process.

HOW TO USE IT –

TURN the FUNCTION switch to position 2.

PUSH the POWER switch to the ON position.

PUSH the DISPLAY switch to the ON position.

PUSH the RESET pushbutton. The display will be blank.

PRESS the S/S pushbutton at the beginning of the overall event. Do not press F/S until the overall event is finished.

PRESS S/S a second time (at the end of the first lap, for example) to measure and display the elapsed time of the first individual event (lap). This second S/S entry simultaneously stops counter A, displays its elapsed time, clears it to zero and restarts it counting again; but does not effect the total elapsed time accumulating in counter B.

FURTHER S/S entries simultaneously display the new time elapsed in counter A, clear it to zero, and restart it counting again.

TURN the DISPLAY switch off and back on to observe the counting process.

PRESS F/S as the overall event ends. This stops both counter A and counter B. The time displayed is that of counter A (the last individual event time).

PRESS S/S to display the total elapsed time of counter B. Further S/S entries alternate the display between the time in counter A (the last individual event time) and the time in counter B (the total elapsed time).

TURN the DISPLAY switch off any time you wish. This will conserve battery power.

EXAMPLE –

At the Indianapolis 500 mile race you plan to time your favorite driver on each sequential lap. Just before race time you should check your Stopwatch to make sure it is in its ready state. Then, as the green starting flag is waved to start the race or as he passes your vantage point, press the S/S pushbutton. Press the S/S pushbutton again as your driver crosses the start-finish line (or your vantage point) at the end of the first lap. The time displayed is the elapsed time of the first lap. Even though counter A is now counting lap 2, the display still shows the elapsed time of the first lap. If you want to see the count progress for lap 2, turn the DISPLAY switch off and back on. Press S/S at the end of each subsequent lap to display the elapsed time for that lap. Press F/S as your driver receives the checkered flag on the final lap. The time displayed is the time elapsed from the last S/S entry. Press the S/S pushbutton again to display the total elapsed time of the race.

This function of your Stopwatch is also quite useful for measuring the time interval between two race cars. Suppose you want to measure the time interval between race leader William (Willie) Winnet and the second place car driven by Kenneth (Kenny) Ketcham. Press S/S as Willie crosses the start-finish line to start the timing process. Then press S/S again as Kenny crosses the start-finish line. The time displayed is the time interval between the two race cars.

Function 3... Accumulated-Total Elapsed Time

WHAT IT DOES –

1. Counter B measures the total elapsed time of an overall event.
   - It counts from the first S/S entry to the first F/S entry.
2. Counter A totals the activity time of an event.
   - It counts initially from the first S/S entry to the second S/S entry.
   - Further S/S entries alternately resume the count where it left off; then stop the counting in counter A.

HOW TO USE IT –

TURN the FUNCTION switch to position 3.

PUSH the POWER switch to the ON position.

PUSH the DISPLAY switch to the ON position.

PUSH the RESET pushbutton. The display will be blank.

PRESS the S/S pushbutton at the beginning of the overall event. Do not press F/S until the overall event is finished.

PRESS S/S a second time as the first individual event (leg, interval) ends. The display shows the time elapsed for the first event. Counter B continues to accumulate the total elapsed time.

FURTHER S/S entries alternately resume the counting in counter A (as the event resumes); then stop the count (as another leg of the overall event ends).

PRESS F/S as the overall event ends. This stops both counters A and B. The time displayed is the total (accumulated) activity time.

PRESS S/S again to display the total elapsed time of counter B.

TURN the DISPLAY switch off any time you wish. This will conserve battery power.

EXAMPLE –

You and a pilot friend have planned a cross-country trip that includes an intermediate stop for refueling, lunch, etc. Just prior to take off, make sure your Stopwatch is in its ready state. Then, as you take off, press the S/S pushbutton. Press S/S again when you land at your first stop. The actual flight time (accumulating in counter A) stops, but the total elapsed time continues to accumulate in counter B. As you take off again, press the S/S pushbutton. Press F/S when you land at your final destination. The time displayed is the total (accumulated) flight time. Press S/S to obtain the total elapsed time from the point of departure to the final destination.

Function 4... Split-Total Elapsed Time

WHAT IT DOES –

1. Counter B measures the total elapsed time of an overall event.
   - It counts from the first S/S entry to the first F/S entry.
2. Counter A also measures total elapsed time, but it provides an updated display of the elapsed time for each S/S entry.

HOW TO USE IT –

TURN the FUNCTION switch to position 4.

PUSH the POWER switch to the ON position.

PUSH the DISPLAY switch to the ON position.

PUSH the RESET pushbutton. The display will be blank.

PRESS the S/S pushbutton at the beginning of the overall event. Do not press F/S until the overall event is finished.

PRESS S/S a second time at a predetermined distance from the start to measure and display the elapsed time to that point. This second S/S entry displays the instantaneous contents of counter A, but does not stop (or reset) it.

FURTHER S/S entries at other predetermined points measure and display the elapsed time to those points.

TURN the DISPLAY switch off and back on to observe the counting process.

PRESS F/S as the overall event ends. This stops both counters A and B. The time displayed is that of both counters A and B (the total elapsed time).

EXAMPLE –

You are a spectator at a skiing slalom event and you will time each skier as he competes. Before the first skier starts, make sure your Stopwatch is in its ready state. Then as the first skier leaves the gate, press the S/S pushbutton. Press S/S again when he reaches the first "split" point. Record the displayed time. Press S/S again when the skier reaches the second "split" point and record the display time. Press F/S when he crosses the finish line and record the total elapsed time. The second skier is timed in the same manner as the first; however, his "split" times can be compared with those of the first skier to determine his progress, and on which part of the course he is gaining or losing time.

Function 5... Start/Stop-Accumulated Activity Time

WHAT IT DOES –

1. Counter A times individual events.
   - It counts initially from the first S/S entry to the second S/S entry.
   - Further S/S entries alternately clear counter A to zero and restart it counting; then stop counting in counter A.
2. Counter B accumulates the individual time intervals measured by counter A.
   - It counts initially from the first S/S entry to the second S/S entry.
   - Further S/S entries alternately resume the counting in counter B from where it stopped; then stop the counting of counter B.
   - Counting is stopped in both counters A and B on first F/S entry.

HOW TO USE IT –

TURN the FUNCTION switch to position 5.

PUSH the POWER switch to the ON position.

PUSH the DISPLAY switch to the ON position.

PUSH the RESET pushbutton. The display will be blank.

PRESS the S/S pushbutton at the beginning of the overall event. Do not press F/S until the overall event is finished.

PRESS S/S a second time (at the end of the first event, for example) to measure and display the elapsed time of the first individual event. This second S/S entry simultaneously stops counters A and B and displays the elapsed time in counter A.

FURTHER S/S entries simultaneously clear counter A to zero and restart the counting in counters A and B; then stop counting in both counters. Counter A starts counting from zero. Counter B resumes counting from where it stopped.

PRESS F/S as the overall event ends. This stops counter A and counter B. The time displayed is the time elapsed from the last S/S entry.

PRESS S/S to display the total elapsed time of counter B. Further S/S entries alternate the display between the time in counter A (the last individual event time) and the time in counter B (the accumulated activity time).

TURN the DISPLAY switch off any time you wish. This will conserve battery power.

EXAMPLE –

You have planned to drive from your home to visit friends in another state and you will make several stops before you arrive. You will use the Stopwatch to measure the driving time between stops and to keep track of actual driving time. Just before you leave, make sure your Stopwatch is in its ready state. Then, as you begin your trip, press the S/S pushbutton. Press S/S again as you make your first stop. The time displayed is the time elapsed to the first stop. Press S/S each time you resume your trip and each time you stop. The time displayed is that for each respective leg of your trip. Press F/S when you reach your destination. The time displayed is the elapsed time of the last leg of your trip. Press S/S to display the accumulated activity (driving) time.

Function 6...Programmable Up Count

WHAT IT DOES –

1. Counter B stores a programmed number.
2. Counter A counts from 0 to the number in counter B.
   - It starts counting from 0 on the first S/S entry.
   - It stops and resumes count on alternate S/S entries.
   - Counting stops and an alarm output signal appears at the alarm output jack when the time of counter A is coincident with the time in counter B.

PROGRAMMING

Either of two methods can be used to program the Stopwatch counters. The "Digit Set Method" allows you to set digits 1, 2, 3, 4, and 5 to a desired number. You cannot set the tens of hours, tenths of seconds, or hundredths of seconds using this method. The "Learn Method" allows you to time a single event and then enter (learn) the time into the Stopwatch counters. Since the learn method enters the number from counter B (total elapsed time) into the Stopwatch programmable counter, only one event time should be measured and then learned. That is, since multiple S/S entries measure more than one event time, a single S/S entry should be made to start the measurement and a single F/S entry to stop the measurement.

Digit Set Method

Figure 1-1 (in the Illustration Booklet) shows how the digits of the display correspond to the positions of the FUNCTION switch.

TURN the POWER switch to the ON position.

TURN the DISPLAY switch to the ON position.

TURN the FUNCTION switch to position 7.

PRESS the RESET pushbutton. All zeros will be displayed.

PRESS the F/S pushbutton.

TURN the FUNCTION switch to position 1 (to set digit 1).

PRESS and hold the S/S pushbutton.

PRESS and hold the F/S pushbutton. Digit 1 will repeatedly count 0 through 9.

RELEASE F/S quickly as the desired number (hours) appears. Continue holding the S/S pushbutton.

TURN the FUNCTION switch to position 2 (to set digit 2).

PRESS and hold the F/S pushbutton. Digit 2 will repeatedly count 0 through 5.

RELEASE F/S quickly as the desired number (tens of minutes) appears.

TURN the FUNCTION switch to position 3 (to set digit 3).

PRESS and hold the F/S pushbutton. Digit 3 will repeatedly count 0 through 9.

RELEASE F/S quickly as the desired number (minutes) appears.

TURN the FUNCTION switch to position 4 (to set digit 4).

PRESS and hold the F/S pushbutton. Digit 4 will repeatedly count 0 through 5.

RELEASE F/S quickly as the desired number (tens of seconds) appears.

TURN the FUNCTION switch to position 5 (to set digit 5).

PRESS and hold the F/S pushbutton. Digit 5 will repeatedly count 0 through 9.

RELEASE F/S quickly as the desired number (seconds) appears.

RELEASE the S/S pushbutton.

TURN the FUNCTION switch to position 6.

VERIFY the time displayed. If a digit is incorrect, turn the FUNCTION switch to the appropriate position, press hold S/S, and press F/S until the correct number appears. Then release both pushbuttons and turn the FUNCTION switch to position 6.

PRESS the LOAD (RESET) pushbutton to enter the displayed (programmed) number into the Stopwatch counters.

Proceed to "HOW TO USE IT."

Learn Method

TURN the POWER switch to the ON position.

TURN the DISPLAY switch to the ON position.

PRESS the RESET pushbutton.

TURN the FUNCTION switch to position 2, 3, or 4. NOTE: Positions 1 and 5 can also be used if the internal sequencing error of .02 seconds (maximum) that can occur is not significant to your timing measurements.

PRESS S/S to begin the timing sequence.

PRESS F/S when the timing sequence (or event) ends.

TURN the FUNCTION switch to position 6.

PRESS the LOAD (RESET) pushbutton to enter (learn) the displayed number into the programmable counter.

NOTE: The time accumulated in counter B (usually the total elapsed time) can be entered into the Stopwatch by performing only the two previous steps.

HOW TO USE IT –

PROGRAM and LOAD a desired time as explained above.

PRESS S/S to start the up-count. Counting will stop when it reaches the programmed count.

NOTES:

1. You can alternately press S/S to stop and then resume the count before it reaches the programmed count.

2. An alarm can be interfaced to the alarm output jacks to provide an alarm signal or command. See "Optional Inputs And Outputs."

3. DO NOT turn the DISPLAY switch off in Function 6. The DISPLAY switch is normally used to turn off the display to conserve power. It is also used to release internal latches which allow you to see the counting process for functions 2 and 4. However, when the DISPLAY switch is turned off in functions 6 or 7 the minutes and hundredths of seconds digits are simultaneously placed in an undesired and invalid digit set mode. This will alter your programmed number.

4. PRESS the LOAD (RESET) pushbutton to reload the programmed number prior to another up-count sequence.

EXAMPLE –

You have set up your camera on a hillside overlooking a picturesque city to take several time exposures at night. You will use the Stopwatch and one of the alarm circuits you have constructed to serve as a timer with an audible alarm. Before you take your first picture, make sure your Stopwatch is in its ready state and programmed with the desired exposure time. Then, press the S/S pushbutton and open the camera shutter at the same time. When the alarm sounds, close the shutter. Reposition your camera for the next picture. Then press the LOAD (RESET) pushbutton to reload the programmed time. Then, as before, press S/S and open the shutter at the same time. Again, close the shutter as the alarm sounds. You can continue taking pictures using this procedure, or even reprogram the Stopwatch for another exposure time.

Function 7... Programmable Down Count

WHAT IT DOES

1. Counter A stores a zero.

2. Counter B counts down from a programmed number to the number in counter A (0).

   - Starts counting down from the programmed number on the first S/S entry.

   - Stops and resumes count on alternate S/S entries that occur prior to the end of the countdown.

   - Counting stops and an alarm output signal appears at the alarm output jack when the time of counter B is coincident with the time in counter A (0).

HOW TO USE IT

PROGRAM and LOAD a desired time as explained in the "Programming" section of Function 6.

TURN the FUNCTION switch to position 7.

Wait approximately 10 seconds before you proceed. This short pause will make sure the programmed number is properly entered in the countdown register.

PRESS S/S to start the down-count. Counting will stop when it reaches zero (the number stored in counter A).

NOTES:

1. You can alternately press S/S to stop and resume the down-count before it reaches zero.

2. An alarm can be interfaced to the alarm output jacks to provide an alarm signal or command. See "Optional Inputs and Outputs."

3. The Stopwatch must be reprogrammed each time you use the down-count function.

4. Do not turn the DISPLAY switch off in Function 7.

EXAMPLE

As a teacher, you will give your class a 20-minute timed test. You will use the Stopwatch and one of the alarm circuits you have constructed to serve as a timer with an audible alarm. Before the test begins, make sure the Stopwatch is in its ready state and programmed for 20 minutes. Make sure you turn the Function switch to position 7. Then press S/S to start the test. When the alarm sounds, the time is up. If the test must be interrupted (for a break, intermission, etc.) and then resumed, press S/S to stop the down-count. Press S/S again to resume the down-count.

OPTIONAL INPUT AND OUTPUT ALARM CIRCUITS

This section of the Manual shows some examples of the kinds of circuits you can use for an input or output to plug into the input jacks on your Stopwatch. The components that make up these circuits are not supplied with your kit and must be purchased. Other circuits will also work.

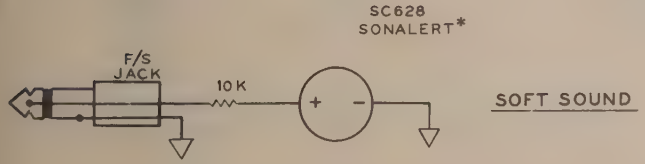


Figure 1-2

Figure 1-2 shows an output alarm circuit using a Sonalert, Model SC628. This circuit produces a low volume sound and is powered by the batteries in your Stopwatch.

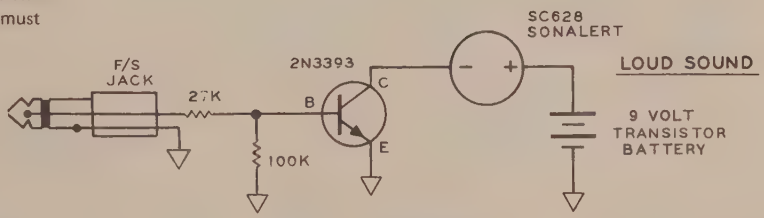


Figure 1-3

Figure 1-3 shows a circuit which also uses a Sonalert Model SC628. In addition, however, this circuit has a transistor amplifier stage. Because of the amplifier stage, this circuit produces a louder, more attention-getting sound.

*P.R. Mallory and Co. Registered Trademark

Figure 1-4 shows a circuit that uses a 6 VDC Relay. The relay should activate in less than 1 millisecond, ten times faster then the resolution of your Stopwatch. The input to an alarm circuit can be connected to the normally-open contacts of the relay. The contacts are rated at 120 volts AC, .42-ampere. If your alarm circuit power requirements are greater than this rating, you can use the relay in this circuit to control another relay with a higher rating which would control your alarm circuit.

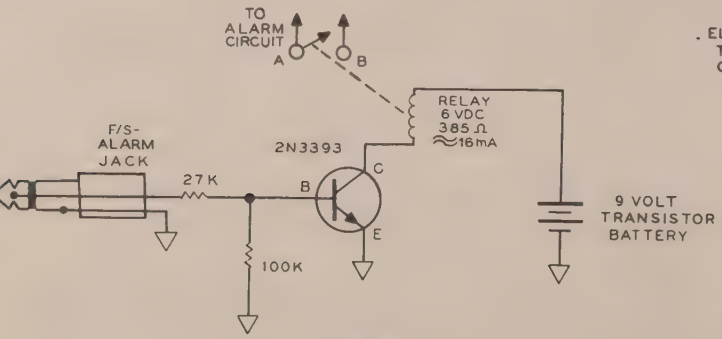


Figure 1-4

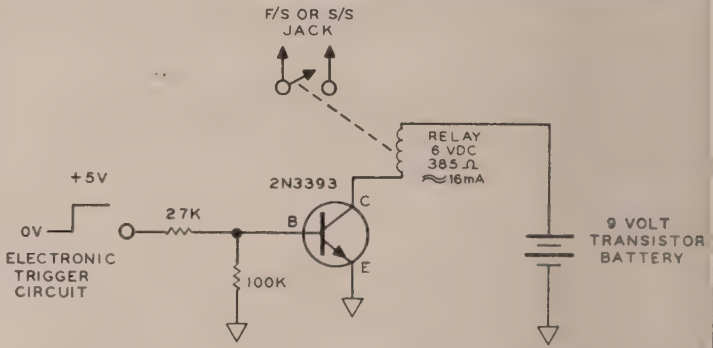


Figure 1-5

Figure 1-5 shows the same circuit as Figure 1-4 except that the relay is used to externally control the S/S or F/S functions of your Stopwatch. The circuit itself can be controlled by an electric triggering circuit. The trigger circuit must have an output of 0 to 5 volts minimum. The circuit that is shown is turned on when the output of the trigger circuit goes to 5 volts.

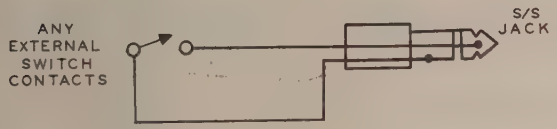


Figure 1-6

Figure 1-6 shows any set of normally-open switch lugs connected to the S/S jack of your Stopwatch. The switch can then be used as a remote S/S switch.

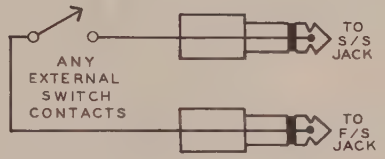


Figure 1-7

Figure 1-7 shows how a set of normally-open switch contacts are used to remotely control the F/S function. CAUTION: Never connect the center (tip) of the S/S jack, J302, to the sleeve (collar) of the F/S jack, J303, as these are the positive (+) and negative (—) battery points respectively.

ALIGNMENT WITH INSTRUMENTS

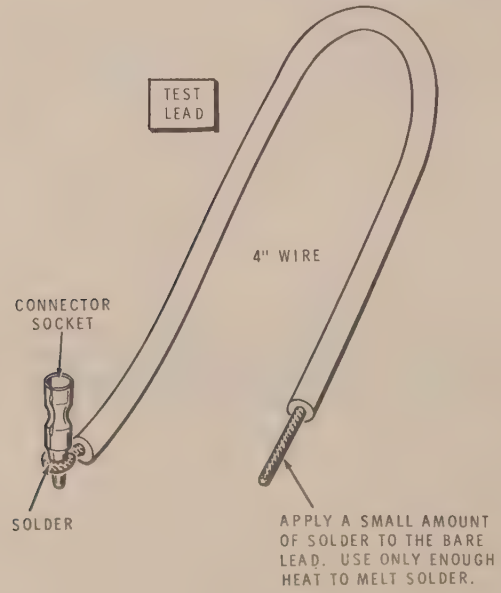

TEST LEAD
4" WIRE
CONNECTOR SOCKET
SOLDER
APPLY A SMALL AMOUNT OF SOLDER TO THE BARE LEAD. USE ONLY ENOUGH HEAT TO MELT SOLDER.

Figure 2-1

You should perform the steps in this section only if you doubt the accuracy of your Stopwatch. You will need a frequency counter capable of measuring 100.000 Hz ±.001 Hz.

Refer to Figure 2-1 for the following steps.

( ) Prepare a 4" red wire and a 4" black wire.

( ) Locate the remaining two connector sockets.

( ) Solder one end of the red wire to the tip of one of the plug connectors.

( ) Solder one end of the black wire to the tip of the other plug connector.

Refer to Figure 2-2 (in the "Illustration Booklet") for the following steps.

( ) Make sure the POWER switch (SW201) is in the OFF position.

( ) Remove the FUNCTION switch knob.

( ) Remove the cabinet bottom from the Stopwatch. Save the three screws.

( ) Remove the main circuit board and the battery pack.

( ) Disconnect the main circuit board and position it component side up on the foam gasket.

( ) Push the plug connector on the red wire onto circuit board plug pin 1 on the display circuit board.

( ) Insert the bare wire end of the red wire into plug connector 1 on the main circuit board.

( ) Push the plug connector on the black wire onto circuit board plug 11 on the display circuit board.

( ) Insert the bare wire end of the black wire into plug connector 11 on the main circuit board.

( ) Connect the common lead of the frequency counter to the plug connector on the black wire.

( ) Set up the frequency counter to read 100.000 Hz. Then turn the counter on.

( ) Push the POWER switch on the Stopwatch to the ON position.

NOTE: In the next step, be sure the test probe does not slip off the IC pin and short to another pin.

( ) With the test probe of the frequency counter, touch IC102 pin 15. Then, as you hold the probe on pin 15, use a small nonmetallic screwdriver to adjust C101 for a frequency counter reading of 100.000 Hz. NOTE: You can use a metal screwdriver, but its metal blade will cause the clock frequency to change as it nears the trimmer capacitor. Make slight adjustments and read the frequency counter only after you remove the screwdriver from the trimmer capacitor. Repeat this procedure several times to obtain the correct frequency.

( ) Remove the test probe from IC102.

( ) Push the POWER switch on the Stopwatch to the OFF position.

( ) Disconnect the common lead of the frequency counter.

( ) Remove the red wire from between the two circuit boards.

( ) Remove the black wire from between the two circuit boards.

( ) Reinstall the main circuit board and the battery pack.

( ) Reinstall the cabinet bottom.

( ) Reinstall the FUNCTION switch knob.

This completes the "Alignment With Instruments."

IN CASE OF DIFFICULTY

This section of the Manual is divided into two parts. The first part, titled "General Troubleshooting Information," describes what to do about the difficulties that may occur right after your Deluxe Digital Stopwatch is assembled.

The second part, titled "Troubleshooting Chart," is provided to assist you in servicing the Stopwatch if the "General Troubleshooting Information" fails to clear up the problem, or if difficulties occur after your Stopwatch has been in use for some time. The "Troubleshooting Chart" lists a number of possible difficulties that could arise along with several possible solutions to those difficulties.

Try to analyze the symptoms of any problem you might have before starting any troubleshooting procedure. You can usually accomplish this by trying the various functions of your Stopwatch to detemine abnormal operations. A review of the Operation section may help your analysis.

NOTE: Refer to the "Circuit Board X-Ray Views" on Page 76 for the physical location of parts on the circuit boards.

GENERAL TROUBLESHOOTING INFORMATION

1. Check all the wires that are connected between the circuit boards and other parts. Trace each wire in colored pencil on the Pictorial as it is checked. Make sure these wires are connected to the proper points and are properly soldered. Someone who is not familiar with the unit may notice something you have consistently overlooked.

2. About 90% of the kits that are returned for repair do not funciton properly because of poor connections and soldering. Therefore, you can locate many troubles by a careful inspection of connections to make sure they are soldered as described in the "Soldering" section of the "Kit Builders Guide." Reheat any doubtful connections.

3. Closely examine each circuit board foil in a good light to see that no solder bridges exist between adjacent connections. If available, a magnifying glass would be helpful for this purpose. Remove any solder bridges by holding a clean, hot soldering iron tip between the two points that are bridged until the excess solder flows down onto the tip. Compare your foil pattern against the "X-Ray Views" on Page 76.

4. Be sure the transistor is in its proper location. Be sure that each lead is in the right hole and has a good solder connection to the foil. Recheck to see if you installed them as shown on Page 35.

5. Check the integrated circuits for proper positioning. (Be sure the pin 1 end of each IC is near the marked end of the outline on the circuit board.) Be sure each IC pin is making good contact with its socket. If you remove or handle an IC, be sure to observe the precautions as explained on Pages 18 and 35.

CAUTION: If it is ever necessary to solder or reheat a connection on a circuit board, remove the integrated circuits first. Always place integrated circuits that have been removed in the conductive foam until you reinstall them.

6. Check each capacitor value. Be sure that a capacitor of correct value is installed at each capacitor location.

7. Check each resistor value carefully. It would be easy, for example, to install an 1800 Ω (brown-gray-red) resistor where a 180 kΩ (brown-gray-yellow) resistor is called for. A resistor that is discolored, or cracked, or shows any sign of bulging would indicate that it is damaged and should be replaced. Since damaged resistors are often the result of some other difficulty (such as faulty wiring), you should find out what caused the damage before you replace the part.

8. Be sure the correct diode is installed at each diode location, and that the banded end is positioned correctly.

9. Check all component leads connected to the circuit boards. Make sure the leads do not extend through the circuit board and come in contact with other connections or parts.

If you still cannot locate and correct the trouble after the above tests are completed, and if a voltmeter is available, check your Stopwatch voltages against the voltages shown on the Schematic Diagram (in the Illustration Booklet) and in the "Circuit Board X-Ray Views" (Page 76).

NOTE: In an extreme case where you are unable to resolve a difficulty, refer to the "Customer Service" information inside the rear cover of the Manual. Your Warranty is located inside the front cover of the Manual.

Precautions for Troubleshooting

1. Be sure you do not short any adjacent terminals or foils when making voltage measurements. If the probe should slip, for example, and short together two adjacent connections, it is very likely to damage an IC, transistor or diode.

2. Be especially careful when testing any circuit that contains an IC or transistor. Although these components have an almost unlimited life when used properly, they are much more vulnerable to damage from excessive voltage or current than many other parts.

Troubleshooting Charts

This chart lists the condition and possible cause of several malfunctions. If a particular part or parts are mentioned (IC201 for example) as a possible cause, check that part to see that it was installed and/or wired correctly. It is also possible, on rare occasions, for a part to be faulty and require replacement.

PROBLEM	POSSIBLE CAUSE
No display.	1. Display switch SW203 turned off. 2. Blown fuse wires, F1 or F2. 3. Batteries dead or shorted. 4. Jumper wire to IC101 pin 1. 5. Crystal Y101, R101, and R102, C101, C102, or IC101 defective. 6. IC201 defective. 7. IC202 defective.
One or more digits do not light.	1. Associated LED, V201 through V204. 2. IC201 or IC202 defective. 3. IC101 or IC102 defective.
One segment does not light.	1. The associated LED, V201 through V204.
Two identical segments of an LED do not light.	1. Solder connections to that LED. 2. The associated LED, V201 through V204.

PROBLEM	POSSIBLE CAUSE
One segment lights much brighten than others.	1. R201 through R207 defective. 2. The associated LED, V201 through V204.
Off segment (a segment that should not be turned on) glows.	1. IC201 defective. 2. IC101 or IC102 defective.
Off digits (a digit that should not be turned on) glow.	1. IC202 defective. 2. IC101 or IC102 defective. 3. IC202 pushed too far into its socket.
Batteries do not charge.	1. Improper wiring to J301. 2. R208 defective.
Fuse wires blow.	1. Improper wiring to J301. 2. Improper wiring to batteries. 3. Inadvertent short.
No alarm output in Function 6.	1. D104 open. 2. Jumper wire from D104 to IC102 pin 4.
No alarm output in Function 7.	1. D105 open. 2. Jumper wire from D105 to IC102 pin 4.

PROBLEM	POSSIBLE CAUSE
Alarm comes on too soon.	1. D106 shorted.
Function 1 inoperative.	1. Jumper wire to pin 5 of IC101 and IC102 open. 2. IC101, IC102, or SW101 defective.
Function 2 inoperative.	1. Jumper wire to pin 7 of IC101 and IC102 open. 2. IC101, IC102, or SW101 defective.
Function 3 inoperative.	1. Jumper wire to pin 9 of IC101 and IC102 open. 2. D101 shorted. 3. IC101, IC102, or SW101 defective.
Function 4 inoperative.	1. Jumper wire to pin 8 of IC101 and IC102 open. 2. IC101, IC102, or SW101 defective.
Function 5 inoperative.	1. The two jumper wires to pin 6 of IC101 and IC102 open. 2. IC101, IC102, or SW101 defective.
Function 6 inoperative.	1. IC101, IC102, or SW101 defective.
Function 7 inoperative.	1. IC101, IC102, or SW101 defective.

PROBLEM	POSSIBLE CAUSE
Will not program any digit.	1. Q101, R103, SW101, SW102, SW103, IC101, or IC102 defective.
Will not program digit 1.	1. IC102 or SW101 defective.
Will not program digit 2.	1. IC102 or SW101 defective.
Will not program digit 3.	1. D102 open. 2. IC102 or SW101 defective.
Will not program digit 4.	1. D101 open. 2. IC101 or SW101 defective.
Will not program digit 5.	1. IC101 or SW101 defective.
Simultaneously sets digits 3 and 6.	1. D103 shorted.
Counts improperly.	1. Jumper wire to IC101 pin 24 open.
F/S inoperative.	1. D106, D109, SW103, IC101, or IC102 defective.
S/S inoperative.	1. SW102, IC101, or IC102 defective.

SPECIFICATIONS

Accuracy	Without alignment: ±.003% at 80° F. Optional instrument alignment provides precision calibration at the calibration temperature.
Accuracy Versus Temperature	+0.0%, −.003% from 25°F to 120°F when calibrated at 80°F.
Measuring Range	99 hours, 59 minutes, 59.99 seconds.
Programmable Range	9 hours, 59 minutes, 59 seconds.
Time Resolution	.01 seconds.
Operating Temperature Range	−10°F to +120°F.
Power Supply	Six 1.2 volt rechargeable nickel cadmium batteries, or; Model GB-1201: a 9 volt charger operating from 120 VAC 60 Hz. Model GB-1201E: a 9 volt charger operating from 120/240 VAC 50/60 Hz.
Battery Life	Approximately 40 hours with displays mostly off. Approximately 4 hours with displays continuously lighted.
Circuitry	2 PMOS Custom IC's interfaced with bipolar and CMOS devices.
Display	8 LED digits.
Weight	Approximately 8 ounces.
Dimensions	5-1/3" high x 2-1/16" wide x 2" deep.

The Heath Company reserves the right to discontinue products and to change specifications at any time without incurring any obligation to incorporate new features in products previously sold.

CIRCUIT DESCRIPTION

Refer to the Block Diagram and to the Schematic Diagram (in the Illustration Booklet) while you read the following information. The pin numbers of the two 40-pin integrated circuits are shown on the Block Diagram so you can relate their various input and output functions with the actual wiring shown on the Schematic Diagram.

All of the timing is performed by digital logic within the two identical 40-pin integrated circuits, IC101 and IC102. Each integrated circuit is an Ion Implantation Depletion Mode, P-Channel, MOS* device (I^2D PMOS). The remaining circuitry supplies DC power, provides timing, controls the input-output (I/O) program for each function, and interprets the sequentially multiplexed digit and seven segment information that is displayed on the eight LED (Light Emitting Diode) readouts.

The I/O circuitry programs both IC101 and IC102 by applying voltage to the appropriate inputs for the selected function. The divide scaler inputs determine how high each digit counts before initiating a carry to the next serial digit. Resolution select inputs set the count resolution at 1/100 second. A crystal-pi-network supplies a 32.8 kHz signal to pins 19 and 20. This signal is internally divided by 328 to provide a clock frequency of 100 Hz, and is coupled from pin 15 of IC101 to pin 15 of IC102.

When the programmable functions (6 and 7) are selected, the comparator enable input enables the alarm circuitry. Diode D104 couples the required positive voltage to pin 4 of IC102 in function 6. Diode D105 couples the required positive voltage to pin 4 of IC102 in Function 7. Diode D106 inhibits an early alarm level output while D109 isolates the alarm level output from interfering with the digit set programming. The program lines are used for Function 6 and 7 as digit set lines. Diodes D101, D102, and D103 provide isolation to the other circuits during digit set programming.

*Metal Oxide Semiconductor.

The reset input clears all internal registers in functions 1, 2, 3, 4, 5, and 7. In function 6, it clears all registers except programmable counter B. Start/Stop initiates the timing of intervals and it commands intermediate actions, depending upon the function selected. After Final Stop, Start/Stop entries alternately display the contents of counters B and A. A Final Stop input or a comparator output (alarm level) inhibits all internal counting. In functions 6 and 7 a voltage level-shift appears when the counting reaches coincidence with the programmed time. The Function switch controls the function select input lines, which determine the program sequence.

The clock input/output, multiplex output, and control counters A and B of IC101 provide clock, multiplex, and cascade count to IC102. The BCD (Binary Coded Decimal) 1, 2, 4, 8 lines of both IC101 and IC102 form a wired OR circuit that interfaces to the input of IC201, a BCD-to-seven segment decoder. This integrated circuit sources segment current of the appropriate common segments, in the 8-digit LED display, that are determined by the BCD word input. The 4-bit BCD information is sequentially multiplexed and alternates between IC101 and IC102 with tri-state logic level outputs to prevent two 4-bit words from occurring simultaneously. The 8-digit lines of IC101 and IC102 sequentially (serially) enable the digit select lines of IC202, lighting the digit that corresponds to the seven segment information that is present.

The digit set program, which is enabled when the S/S and F/S pushbuttons are pressed simultaneously, saturates Q101 and places positive voltage on pins 10 of both IC101 and IC102.

Six 1.2 volt AA nickel cadmium batteries supply 7.2 volts to all circuits. Resistor R208 limits the charging current to approximately 50 milliamperes.

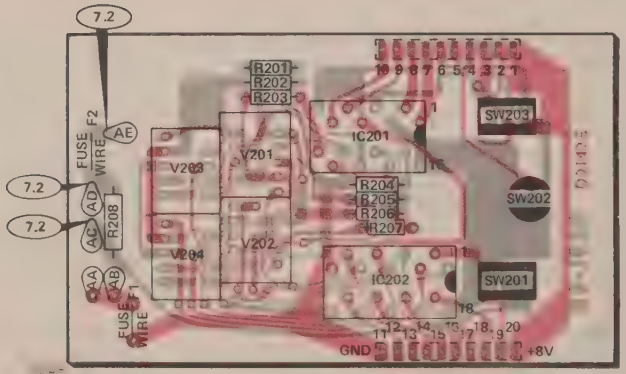
CIRCUIT BOARD X-RAY VIEWS
(Viewed from component side)

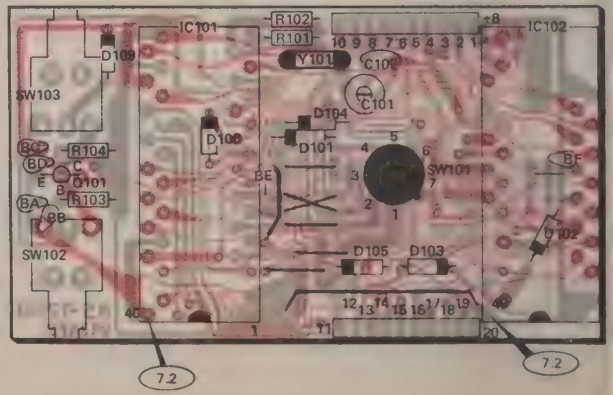
NOTE: To find the PART NUMBER of a component for the purpose of ordering a replacement part:

A. Find the circuit component number (R5, C3, etc.) on the "X-Ray View."

B. Locate this same number in the "Circuit Component Number" column of the "Parts List" in the front of this Manual.

C. Adjacent to the circuit component number, you will find the PART NUMBER and DESCRIPTION which must be supplied when you order a replacement part.

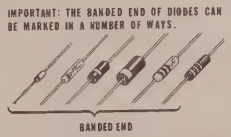
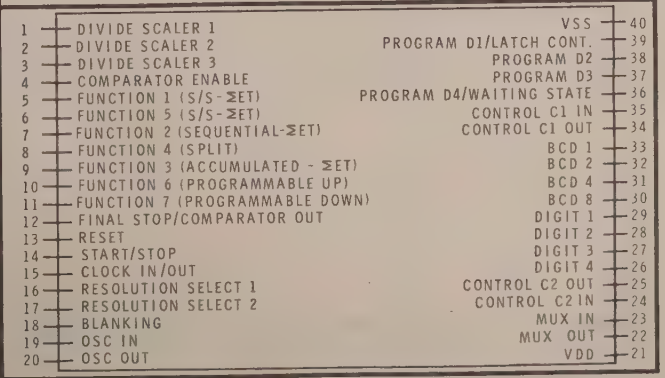




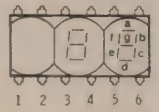
(Component side foil shown in red)

IDENTIFICATION CHARTS

MAIN CIRCUIT BOARD

COMPONENT	HEATH PART NO.	MAY BE REPLACED WITH	IDENTIFICATION
D101, D102, D103, D104, D105, D106, D109	56-56	1N4149	
D201	57-65	1N4002	
Q101	417-235	2N4121	
IC101, IC102	443-693	—	

DISPLAY CIRCUIT BOARD

COMPONENT	HEATH PART NO.	MAY BE REPLACED WITH	IDENTIFICATION
IC201	443-699	MM14511	
IC202	443-700	DM8863	
V201, V202, V203, V204	411 832	—	

PIN	CONNECTION
1	*NC
2	E ANODE
3	D ANODE
4	#2 CATHODE
5	C ANODE
6	*NC
7	#3 CATHODE
8	B ANODE
9	G ANODE
10	A ANODE
11	F ANODE
12	*NC

* NO CONNECTION

FOR PARTS REQUESTS ONLY

- Be sure to follow instructions carefully.
- Use a separate letter for all correspondence.
- Please allow 10 - 14 days for mail delivery time.

SEND TO:

HEATH COMPANY
BENTON HARBOR
MICHIGAN 49022
ATTN: PARTS REPLACEMENT

Phone (Replacement parts only):
616 982-3571

DO NOT WRITE IN THIS SPACE

INSTRUCTIONS

- Please print all information requested.
- Be sure you list the correct **HEATH** part number exactly as it appears in the parts list.
- If you wish to prepay your order, mail this card and your payment in an envelope. Be sure to include 10% (25¢ minimum, $3.50 maximum) for insurance, shipping and handling. Michigan residents add 4% tax.

Total enclosed $_____

- If you prefer COD shipment, check the COD box and mail this card. COD ☐

NAME _____

ADDRESS _____

CITY _____

STATE _____ ZIP _____

The information requested in the next two lines is not required when purchasing nonwarranty replacement parts, but it can help us provide you with better products in the future.

Model # _____ Invoice # _____

Date Purchased _____ Location Purchased _____

LIST **HEATH** PART NUMBER	QTY.	PRICE EACH	TOTAL PRICE
TOTAL FOR PARTS			
HANDLING AND SHIPPING			
MICHIGAN RESIDENTS ADD 4% TAX			
TOTAL AMOUNT OF ORDER			

THIS FORM IS FOR U.S. CUSTOMERS ONLY — OVERSEAS CUSTOMERS SEE YOUR DISTRIBUTOR

CUSTOMER SERVICE

REPLACEMENT PARTS

Please provide complete information when you request replacements from either the factory or Heath Electronic Centers. Be certain to include the **HEATH** part number exactly as it appears in the parts list.

ORDERING FROM THE FACTORY

Print all of the information requested on the parts order form furnished with this product and mail it to Heath. For telephone orders (parts only) dial 616 982-3571. If you are unable to locate an order form, write us a letter or card including:

- Heath part number.
- Model number.
- Date of purchase.
- Location purchased or invoice number.
- Nature of the defect.
- Your payment or authorization for COD shipment of parts not covered by warranty.

Mail letters to: Heath Company
Benton Harbor
MI 49022
Attn: Parts Replacement

Retain original parts until you receive replacements. Parts that should be returned to the factory will be listed on your packing slip.

OBTAINING REPLACEMENTS FROM HEATH ELECTRONIC CENTERS

For your convenience, "over the counter" replacement parts are available from the Heath Electronic Centers listed in your catalog. Be sure to bring in the original part and purchase invoice when you request a warranty replacement from a Heath Electronic Center.

TECHNICAL CONSULTATION

Need help with your kit? — Self-Service? — Construction? — Operation? — Call or write for assistance. you'll find our Technical Consultants eager to help with just about any technical problem except "customizing" for unique applications.

The effectiveness of our consultation service depends on the information you furnish. Be sure to tell us:

- The Model number and Series number from the blue and white label.
- The date of purchase.
- An exact description of the difficulty.
- Everything you have done in attempting to correct the problem.

Also include switch positions, connections to other units, operating procedures, voltage readings, and any other information you think might be helpful.

Please do not send parts for testing, unless this is specifically requested by our Consultants.

Hints: Telephone traffic is lightest at midweek — please be sure your Manual and notes are on hand when you call.

Heathkit Electronic Center facilities are also available for telephone or "walk-in" personal assistance.

REPAIR SERVICE

Service facilities are available, if they are needed, to repair your completed kit. (Kits that have been modified, soldered with paste flux or acid core solder, cannot be accepted for repair.)

If it is convenient, personally deliver your kit to a Heathkit Electronic Center. For warranty parts replacement, supply a copy of the invoice or sales slip.

If you prefer to ship your kit to the factory, attach a letter containing the following information directly to the unit:

- Your name and address.
- Date of purchase and invoice number.
- Copies of all correspondence relevant to the service of the kit.
- A brief description of the difficulty.
- Authorization to return your kit COD for the service and shipping charges. (This will reduce the possibility of delay.)

Check the equipment to see that all screws and parts are secured. (Do not include any wooden cabinets or color television picture tubes, as these are easily damaged in shipment. Do not include the kit Manual.) Place the equipment in a strong carton with at least THREE INCHES of *resilient* packing material (shredded paper, excelsior, etc.) on all sides. Use additional packing material where there are protrusions (control sticks, large knobs, etc.). If the unit weighs over 15 lbs., place this carton in another one with 3/4" of packing material between the two.

Seal the carton with reinforced gummed tape, tie it with a strong cord, and mark it "Fragile" on at least two sides. Remember, the carrier will not accept liability for shipping damage if the unit is insufficiently packed. Ship by prepaid express, United Parcel Service, or insured Parcel Post to:

Heath Company
Service Department
Benton Harbor, Michigan 49022

HEATH

Schlumberger

www.manualsplus.com

1030835

HEATH COMPANY • BENTON HARBOR, MICHIGAN

THE WORLD'S FINEST ELECTRONIC EQUIPMENT IN KIT FORM

LITHO IN U.S.A.